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REGULATIONS FOR THE TECHNICAL OPERATION OF INTERURBAN TELEPHONE-TELEGRAPH CABLE LINES

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FOREWORD

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REGULATIONS FOR THE TECHNICAL OPERATION OF INTERURBAN TELEPHONE-TELEGRAPH CABLE LINES

[Following is a translation of the Russian-language monograph Pravila tekhnicheskoy ekspluatatsii kabel'nykh liniy mezhdugorodnoy telefonno-telegrafnoy svyazi published by the Main Administration of Interurban Telephone-Telegraph Communications, Ministry of Communications USSR, 1959, Moscow, pages 1-115.]

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[A number of abbreviations occur frequently throughout the text of the original. They are explained below for convenience.

GUMTTS (Glavnoye upravleniye mezhdugorodnoy telefonno-telegrafnoy svyazi Ministerstva svyazi Soyuza SSR--Main Administration of Interurban Telephone-Telegraph Communications, Ministry of Communications USSR).
KU (Kabel'nyy uchastok--Cable section).
LTU (Lineyno-tekhnicheskiy uzel--Line-technical center).
MKU (Mezhdugorodnyy kabel'nyy uzel--Interurban cable center).
NUP (Neobsluzhivayemyy usilitel'nyy punkt--Non-serviced (i.e., automatic functioning) repeater station).
RKM (Rayon tekhnicheskoy ekspluatatsii kabel'nykh telefonno-telegrafnykh magistraley--Technical operation of cable telephone-telegraph main-line region).
RVB (Remontno-vosstanovitel'nyaya brigada--Repair-replacement crew).
TsNNIIS (Tsentral'ny nauchno-issledovatel'skiy institut svyazi--Central Scientific Research Institute of Communications).
UKM (Upravleniye tekhnicheskoy ekspluatatsii kabel'nykh telefonno-telegrafnykh magistraley--Administration for the Technical Operation of Telephone and Telegraph Main-line Cables).
UP (Usilitel'nyy punkt--Repeater station).
VTU (Vedomstvennyye tekhnicheskiye usloviya--Departmental technical specifications).]

PREFACE

In recent years there has been a considerable increase in the number of cable trunk lines equipped for multiplex, multi-channel, high-frequency communications in telephone and telegraph transmissions, as well as for high-quality broadcasting and, in some cases, television programs.

The seven-year plan for 1959-1965 anticipates a further development of the cable trunk line network through the installing of balanced high-frequency cables with domestically produced multiplex equipment for 24-and 60-channel systems, and of coaxial cables with four coaxial pairs, thus making it possible to set up as many as 1920 telephone channels for each two coaxial pairs, or to transmit 300 telephone conversations and two high-quality television broadcasts simultaneously.

Moreover, single-quad balanced and miniature coaxial cables are to be introduced for intra-republic and oblast communications using multiplex equipment for their multi-channel systems.

Semiconductors and other modern miniature inexpensive products will be widely used in multiplex equipment.

Non-serviced repeater stations will be installed on cable trunk lines to as great an extent as possible, and wide use will be made of remote control and remote signalling.

The uninterrupted and high-quality operation of complicated technical equipment having a great number of communication channels on cable truck lines requires of servicing personnel that they maintain cable equipment in strict conformance with technical standards, and that they continually strive to improve their abilities.

The proper organization regarding work with cable equipment so as to prevent communications work stoppage assumes timely preventive repair operations in order to forestall breakdowns, unrelenting technical supervision over cable main lines, maintenance of electrical specifications and the depth of cable beds according to established standards, the execution of measures to protect cables from corrosion and lightning, the installation of cables under constant full pressure, and a check of technical documentation for their conformance to actuality.

The introduction of new technology in cable main lines and the increased demands upon their operation have brought about considerable changes in the organization of cable-equipment operations. As a result, the Main Administration of Interurban Telephone and Telegraph Communications has published the present book. The regulations treated in this book were compiled on the basis of many years' experience with cable lines and on the basis of previous publications: Pravila tekhnicheskoy ekspluatatsii mezkdugorodnoy telefonnoy svyazi [Regulations for the Technical Operation of Interurban Telephone Lines], published in 1957, and Pravila po stroitel'stvu mezhdugorodnykh kabel'nykh liniy svyazi [Regulations for Constructing Interurban Cable-Line Communications], published in 1958.

The regulations are obligatory for the engineer and technical personnel of the cable main-line administrations, oblast administrations, and republic communications ministries which serve the radio cables joining radio bureaus with transmitting and receiving radio centers, as well as the cable inserts to the overhead lines of interurban telephone and telegraph communications lines.

As a result of the publication of these regulations, Sections 1, 2, 3, and 4 of Rukovodstvo po technicheskoy ekspluatatsii i remontu mezhdugorodnykh kabel'nykh sooruzheniy svyazi [Manual for the Technical Use and Repair of Interurban Cable Communications Facilities] are cancelled.

All comments regarding the present book should be forwarded to Moscow K-9, Gor'kiy Street, 7, Main Administration of Interurban Telephone-Telegraph Communications, Ministry of Communications USSR.

--Technical Administration,
Ministry of Communications USSR

CHAPTER I

GENERAL REGULATIONS

Section 1. Cable lines of interurban telephone and telegraph communications, their use and classification.

1.1.1. Cable lines of interurban telephone and telegraph communications are subdivided into:

a) interurban cable communications lines connecting interurban telephone and telegraph junctions;

b) incoming cables laid at the points where overhead telephone and telegraph communications lines approach telephone and telegraph junctions and repeater stations, and also connecting cables;

c) cable inserts laid at points where overhead communications lines cross reservoirs, railroads, tunnels, and where they intersect power transmission lines;

d) radio cables leading to radio broadcasting equipment rooms (RVA), radio offices, receiving and transmitting radio stations.

1.1.2. Interurban cable lines, lead-in cables, cable inserts, and radio cables are, depending on how they are used, divided into three classes.

A. Interurban cable communications lines.

Class I--trunk cable lines running through the whole Soviet Union, connecting Moscow with republic, kray, and oblast centers, and also connecting the latter with each other;

Class II--(intra-republic, intra-kray, intra-oblast) cable lines connecting republic, kray, or oblast centers with rayons, and also the latter with each other;

Class III--intra-rayon cable lines.

B. Lead-in cables and cable inserts.

Lead-in cables cable inserts and connecting cables are classified according to the highest class of the network and conduits connected to them.

C. Radio cables.

Class I--cable lines running from radio broadcasting equipment rooms and radio offices to main-line radio or center and republic transmitting and receiving radio stations, and cables connecting the receiving and transmitting radio stations of these same networks.

Class II--cable lines running to receiving and transmitting radio stations with an intra-oblast line for radio communications or for local broadcast.

1.1.3. Cable lines are divided into single cable and double cable. Double cable applies only to cable lines where the usual communications system is a four-conduit system, with reception and transmission on two separate cables.

Section 2. The organization of interurban cable line communications.

1.2.1. Interurban cable lines and radio cables of class I make up the main trunk line interurban cable network of the Soviet Union.

The interurban cable communications lines and radio cables of class II comprise the intra-oblast and interurban cable network.

The sum total of these networks comprises the interurban cable network of the Soviet Union.

1.2.2. The over-all management of the technical operation of the interurban cable network of the Soviet Union is the responsibility of the Main Administration of Interurban Telephone-Telegraph Communications, Ministry of Communications USSR (GUMTTS).

1.2.3. The technical operation of the main-line cable communications lines is the responsibility of the administrations for the technical operation of cable telephone and telegraph main lines (UKM) and the Administration of the Moscow Interurban Cable Network (UMMKS), which are subordinate directly to the GUMTTS.

The UKM and the UMMKS operate through the cable telephone and telegraph main-line technical operational rayons (RKM), through interurban cable junctions (MKU), and through cable sections (KU).

1.2.4. The technical operation of interurban cable communication lines of Classes II and III, of lead-in cables and radio cables, is set up by the communications ministries of the Union republics within their territories through oblast or kray communications administrations, through line-technical and interurban cable communications junctions.

Note: In some cases, the operational servicing of the cable lines referred to in 1.2.4 may, with the authorization of GUMTTS, be transferred to the jurisdiction of UKM.

1.2.5. The location and the staff of UKM are determined by the Ministry of Communications USSR. The location and staff of RKM and KU are determined by UKM, which bases its decisions on standards set by the Ministry of Communications USSR.

1.2.6. The location and staffs of MKU are determined by the Ministries of Communications of the Soviet Republics.

1.2.7. The basic mission of the organizations which operate cable lines for interurban telephone and telegraph communications is the maintenance of all equipment in conformance with the established technical standards, keeping it in working order at all times, increasing its effectiveness, developing new equipment through the mobilization of

resources from within, introducing new equipment, and continually attempting to reduce labor and material expenditures.

1.2.8. The basic mission, rights, and responsibility of UKM, RKM, and MKU in the realm of technical operation are defined by these Regulations and by the decrees regarding UKM, RKM, MKU, and KU issued by the Ministry of Communications USSR.

1.2.9. The basic mission of subordinate elements of UKM, RKM, and MKU, as well as the responsibilities, rights, and obligations of their workers, is defined by the decrees and official instructions published by the administrations for main-line cables, by kray and republic (ASSR) administrations for communications, and by the ministries for communications of the Union republics, which are based on these Regulations.

1.2.10. These Regulations define the principal provisions, missions, and measures within the realm of the technical operation of cable lines for interurban telephone and telegraph communications.

In the course of working out these Regulations and after proper regard for the technical operation of interurban telephone communications, the Ministry of Communications USSR has published a manual and a set of instructions which determine the technology and manner for executing the various types of operations associated with the operation of cable lines for interurban telephone and telegraph communications.

CHAPTER 2

THE COMPONENT PARTS OF CABLE LINES FOR INTERURBAN TELEPHONE AND TELEGRAPH COMMUNICATIONS AND THEIR USE

Section 1. The make-up of cable lines for interurban telephone and telegraph communications.

2.1.1. Cable lines for interurban telephone and telegraph communications consist of cables, cable fittings, cable facilities, and auxiliary equipment.

2.1.2. Cables can be telegraph, telephone, broadcast, television, or multi-purpose, depending on the type of communications. They can be underground, underwater, or overhead, depending on where they are laid.

2.1.3. Cables are distinguished by a designator which indicates the use they were designed for, the kind of insulation and twist, the interior design and type of protective sheathing.

The first letter of the designator on the cable indicates the kind of communications it is intended for (for example, MKB is for main lines, TZB is for telephone approach and junction line cables).

The second, and sometimes the third, letter in some multi-purpose cables, indicates the type of twist (TZB is a spiral quad, TDPB is a double pair twist, and so forth).

The letter "S" on the designator indicates that the cable has styro-flex insulation, and the letter "E" indicates that there is a shielded pair in the cable. The last letter (and sometimes the last two) indicate the kind of protective sheathing and the way it was intended to be laid. For example:

a) bare--TZG, TZEG, TDSG, MKG, MKSG, KMKG, KMG, and others are for laying in cable ducts;

b) cable wound with two steel ribbons but without an outside sheath--TZBG, TZEBG, TDSBG, MKBG, MKSBG, KMKBG, KMBG, and others are for laying in collectors, tunnels, and in areas where there are likely to be explosions;

c) cable wound with two steel strips and having an outside sheath--TZB, TZEB, TDPB, MKB, MKSB, KMKB, and others are for laying directly in the ground under normal conditions;

d) cable having flat wire armor with an outser sheath--TZP, TZEP, TDSP, MKP, MKSP, KMKP, KMP, and others for laying in the ground under conditions of stress (in marshy soil, on steep slopes, etc.);

e) cable armored with round steel wire and having an outer sheath--TZK, TZEK, TDSK, MKK, MKSK, KMKK, KMK, and others for laying across rivers and lakes used for navigation.

The basic data and design of cables used in interurban telephone and telegraph communications lines are given in Appendix 1.

Section 2. Cable fittings.

2.2.1. Cable fittings are used for joining factory lengths of cable, for adding on separate electrical and mechanical facilities, for the terminal connection, and for protecting the cable from dangerous voltages and currents.

Cable fittings consist of:

a) connecting sleeves of lead for providing a hermitic seal for factory-length cable joints, and iron sleeves for protecting the lead sleeves from damage;

b) loading coil cases are for loading coils used for reducing attenuation through increased cable-line inductance;

c) load coil spacing elongators for adding electrical length for the cable up to the load coil spacing without laying reserve cable;

d) symmetrical capacitors and anti-communication circuits for making cable symmetrical and for increasing the protection between lines against crosstalk;

e) cable boxes for connecting cable ends in switch panels, cable vaults, cable boxes, and cable huts.

Boxes, depending on their design and the purpose for which the cable connected to them is intended, are classified as:

shielded--for connecting broadcast cable pairs and hf communication pairs;

non-shielded--for connecting lf communication pairs;

coaxial--for connecting coaxial pairs

f) cable boxes for connecting overhead line circuits to cable on cable supports;

g) fuses for protecting cable and station equipment from prolonged and dangerous currents;

h) lightning arrestors for protecting cable and station equipment, as well as servicing personnel, from dangerous voltages;

i) autotransformers for balancing the wave impedance of the multiplex circuits of overhead lines and cables without load coils, as well as for wave impedance cables with input resistances from the mutliplex equipment;

j) cutoff coils for increasing crosstalk attenuation across three single conductor circuits and circuits of the "two conductor--ground" type between input and output amplifiers, as well as for protecting the equipment from the effect of external sources of interference: radio stations, electrified railroads, and power-transmission lines;

k) drainage coils for decreasing the value of equalizing currents (impulses) which distort the transmitted signals of voice telegraph, and also for decreasing attenuation of the required currents for telephone and telegraph transmissions when the lightning arrestors are in operation;

l) load coil units for balancing the wave impedances of the overhead lines of multiplex circuits with the wave impedances of input cables or cable inserts, as well as with multiplex equipment. In addition, load coils reduce cable attenuation.

2.2.2. Cable conduit and terminal equipment is used for laying cable and for attaching cable fittings.

Cable conduit equipment comprises the following:

a) cable conduits with inspection wells and boxes which make possible the laying of new and the repairing of existing cables without digging up the ground;

b) input devices for leading cables into buildings and for arranging distributing and gas-proof sleeves. When leading in a large quantity of cable for arranging input equipment, a special location is selected.

Cable terminal equipment consists of the following:

a) cable huts for distributing protective equipment and terminal cable fittings used for connecting overhead lines to the cable;

b) cable vaults and distribution heads used to house cable boxes in places where cables branch off in several directions or change their capacitance;

c) cable supports for providing space for cable boxes and balancing and protective equipment and for connecting conductors from the overhead lines with cable cores.

Section 3. Auxiliary cable equipment.

2.3.1. Auxiliary cable equipment serves to indicate cable routes, to protect cables from corrosion and dirty, to keep them under constant air pressure, and so forth.

Auxiliary equipment consists of the following:

a) measurement posts for indicating the routes and arrangement of cable sleeves in the area;

b) signal protection signs for indicating the location of cables at river crossings;

c) safety equipment (electric drainage, cathode system, and protective electrodes) for eliminating the corrosion on cable sheathing caused by stray currents or by chemical elements;

d) control-signal equipment for around-the-clock monitoring of safety equipment and for keeping control over the potential between cable sheathing and ground;

e) signal equipment for indicating a decrease in insulation for maintaining a check on the resistance of cable strand insulation with relation to ground;

f) compressor equipment for pumping dry air (gas) into the cable in order to maintain the hermetic sealing of the sheath;

g) low air pressure warning for maintaining the proper amount of air (gas) pressure in the cable;

h) monitor-instrument points for making measurements of stray current potentials on cable sheathing;

i) underground lightning-arrestor bus and cable, overhead current-drain conductors with remote grounds for protecting cables from lightning, and klydonograph registering meters and ferromagnetic recording devices.

CHAPTER 3

PRINCIPAL OPERATIONAL AND TECHNICAL REQUIREMENTS REGARDING INTERURBAN TELEPHONE AND TELEGRAPH CABLE LINES

Section 1. General requirements.

3.1.1. The cable lines must be in such a state that uninterrupted, reliable operation will be assured for all lines connected to them (telephone, telegraph, radio broadcasting, and so forth). Operational maintenance of cable lines must be such as to assure maximum life.

3.1.2. Cables, cable fittings, equipment and auxiliary equipment for cable lines must conform to official state standards (GOST) as regards their physical and electrical characteristics. In the absence of GOST standards, VTU [vedomstvenniye tekhnicheskiye usloviye--departmental technical specifications] or other technical documentation, duly authorized, will be used.

3.1.3. Cable lines, their fittings, equipment and additional equipment, as well as adjacent underground and above-ground equipment, must meet the requirements of the regulations in effect regarding safety and established dimensions.

3.1.4. Cable lines for interurban telephone and telegraph communications must be protected from all kinds of damage, corrosion, and from lightning, as required by these regulations, as well as by manuals and books of instructions now in effect.

Section 2. Cable runs and dimensions.

3.2.1. Cable runs must not be visible (that is, there should not be any dips or ridges along the run, or pits at sleeve junctions).

3.2.2. Along ravine slopes and river banks where the ground is likely to be washed away or where landslides are likely to occur, the earth along the run should be shored up either with turf or paving, or with something similar. In places subject to continual erosion, a by-pass sewer should be constructed for the water; otherwise, the cable should be relaid along a better path.

3.2.3. If the cable run goes across a steep incline (30-45°), the cable must be laid in a zig-zag fashion, in order to avoid having the cable stretched too much for safety in case of landslides, and in order to keep the run from being washed out. On the surface of the run in such places, turf, pavement, and planting supports are to be erected and buttressed in the approved fashion.

3.2.4. When the cable run goes close to steep inclines and river banks and ravines which subject them to washouts, the run must pass by at a safe distance, as determined by the natural slope of the ground. If

this is not done, suitable measures must be taken to eliminate the possibility of landslides and avalanches (accumulation or filling up of basins) or a cable guide should be made.

Note. The angle of the natural slope of the ground and the limits for non-stable soil are given in Appendix 3.

3.2.5. a) For the whole expanse of the run, the standard depth for laying cable, no less than 0.9 m in ordinary soil and no less than 0.4 m in rocky soil, must be maintained.

In cities and other populated points, at special danger points (where the run intersects other underground equipment or goes next to communications cable or other underground communications equipment or cables) cables must be protected with brick, concrete (slag concrete), or tile slabs or laid in asbestos-cement pipes.

At intersections with railroad or streetcar lines, at highway junctures and dirt-road junctures, cables must be laid in asbestos-cement pipes at a depth of no less than 1 m. The ends of the pipes must extend beyond the ditch under the road for at least 1 m.

At populated points which have no underground equipment, and also in highway shoulders, cables must be laid at a depth of at least 1.2 m when they are not protected with brick.

b) at the intersection of navigable streams and rivers having a depth of up to 8 m, communications cables must be buried at least 0.8 to 1 m in the bottom. In those sectors where the depth exceeds 8 m, cable may be laid without being buried in the bottom, with the consent of local interested organizations.

At the intersection of non-navigable rivers, cables must be buried in the bottom at least 0.7 m.

Note. 1. The depth for burying cable can change depending on an agreement and projected bottom markers.

2. In mountain rivers which change their channel and the shape of their floor, the place and depth for laying cable in each instance are determined by plan or by a decision of the chief engineer of the UKM or of the oblast (or kray) communications administration on the basis of an investigation.

c) when roads are being widened or when they are being paved (with asphalt or concrete) along a run, channels must be made for the cables or the cable must be laid in another place.

Note. The necessity for building channels for cables laid under a sidewalk is determined individually in each case, depending upon their size and quantity.

3.2.6. When existing cable runs intersect highways, junctures, streetcar routes, railroads, etc., the cables must be laid in pipes; and at all crossings, at least one pipe must be laid down as a spare.

When cable runs intersect easement ditches, the cables must be buried no less than 1 m lower than the bottom marker of the ditch. If it is buried less deep than that, it must be protected by concrete slabs.

3.2.7. Cables laid along bridges must be protected from mechanical damage by being laid in covered conduits of special ducts or metal pipes firmly attached to the bridge. The cable must be insulated from the metal parts of the bridge and must be insulated from vibration if any is present.

3.2.8. When interurban cable lines, classes I and II (and radio cables, Class I) cross navigable streams and rivers, they must be duplicated by a second set of cables of the same design and capacity for the width of the river's highest flood level.

The main and reserve cables must be of the same length and are to be no less than 100 m from one another for rivers wider than 100 m, and no less than 50 m for rivers less than 100 m wide.

Shore bifuracting junctions must be placed in locations which are never flooded, and in each underwater cable 50% of the cable-line capacity must be held in reserve.

Unused coaxial pairs in underwater cables must be led out in the bifurcating junctions by elongated "fingers" so that a check can be made of their electrical condition without opening up the junction.

Note. One of the underwater cables may be laid along a bridge.

3.2.9. Cable wells must be built in places where distributing boxes for river crossings are located. When a drop to the river runs for 20 to 30 m, the cable should be laid in a zig-zag pattern similar to that used for laying cable in slopes as indicated in "Regulations Governing the Construction of Interurban Cable-Line Communications" (4.5.14).

3.2.10. Cable crossings over navigable streams and rivers must be guarded by warning signs in accordance with the existing regulations regarding navigation over domestic waterways.

Note. Warning signals must be given a marine inspection regarding their conformance to regulations.

3.2.11. The restricted zone along a cable run (1 m on both sides) must satisfy the requirements of existing regulations regarding the layout and safety of telephone and telegraph lines of the Ministry of Communications (Appendix 4).

3.2.12. When cable runs go through unsettled areas, measuring posts must be set up showing the location of joints, the turn angle of the run, and the location of the place where the cable descends for river crossings. A guideline strung from post to post must pass parallel to the cable run at a distance of 1.5 m on the field side (posts on river banks are to be set up 1.5 m downstream from the cable).

Posts must be in a vertical position and have numbers corresponding to the number of sleeves inscribed in black on a white background with a stencil.

The soil around the posts must be treated.

Note. For two-cable systems, the measuring posts are set up only for the "A" cable.

3.2.13. When an interurban cable run intersects other underground facilities, the vertical distance between them must be as follows:

a) when the intersection is with power cables, for communications cables laid in pipe--no less than 0.25 m, and without the pipe--no less than 0.5 m above the power cable;

Note. When power cables are laid shallow and it is impossible to lay them any deeper, communications cable should be laid below the power cable at a depth of not less than 0.25 m lower than the power cable when laid in pipes, and not less than 0.5 m when laid directly in the ground.

b) when the intersection is with water pipes, sewer pipes, heat conduits, and low-pressure gas pipes, armored communications cable must be no less than 0.5 m above these facilities, and cable laid in a pipe must be no less than 0.25 m higher;

c) when the intersection is with telephone channel conduits, cable should be no less than 0.25 m higher or lower, depending on the depth of the channels;

d) when the cable run intersects streetcar lines and railroads, the cable must be laid no less than 1 m from the underside of the rails;

e) when the cable intersects highway and other types of roads, the depth for laying cable should be no less than 1.2 m from the roadbed and no less than 0.8 m under the drain ditch.

When the cable runs across a drain ditch and is laid at a depth less than 0.8 m from the bottom, it must be protected with concrete slabs;

f) when a communications cable (in unpopulated areas) intersects main-line high-pressure-gas conduit runs, the communications cable must be laid out in gas pipes 0.5 m higher than the gas conduits. The pipes must extend no less than 3 m out on both sides.

3.2.14. Underground interurban telephone and telegraph communications cable runs must be located a certain minimum distance from other above-ground and underground facilities as follows:

No.	Type of structure	Minimum distance of cable run from structure
1	Highway and railroad trunkline bridges	
	a) across navigable streams and rivers	300 m downstream
	b) across non-navigable rivers and branches	30 m downstream
2	Dirt, highway, and railroad bridges of local significance only:	
	a) across navigable streams and rivers	50 m downstream
	b) across non-navigable rivers and streams	30 m downstream
3	From the foot of railroad highway, and overpass embankments	5 m
4	Highway and railroad overpasses	50 m
5	Electric railroad contact network supports, railroad signal lights	10 m

No.	Type of structure	Minimum distance of cable run from structure
6	From telephone conduits units and manholes	0.5 m
7	From power cables	0.5 m
8	From urban pipe conduit channels, gas pipes with a pressure of up to 3 kg/cm^2, heat conduits, sewer pipes	1 m
9	From gas pipes with a pressure of from 3 to 10 kg/cm^2 inside cities	10 m
10	From high-pressure gas pipes on rural runs	30 m
11	From distribution water conduit systems	1 m
	From main-line water conduit systems	2 m
12	From overhead-line lightning-arrestor grounds	25 m
13	From overhead-line supports	2 m
14	From house building lines in cities and city-type villages	1 m

3.2.15 When new cables are laid in runs parallel to existing interurban communications cables, the distance between the runs is to be determined in each case depending on the locality and the method of laying (mechanical, or manual).

Section 3. Mechanical and electrical conditions of cables.

3.3.1. Cable laid directly in the ground must have a protective covering (armor, jute) for its entire length, and all lead junction sleeves must be protected with iron sleeves covered with a bituminous coating.

The radius of cable bends must be no less than 15 times the cable's diameter.

3.3.2. Cable sheathing and junction sleeves must be hermetically sealed; and when air pressure is used to check on the condition of the cable, they should not let the pressure drop more than the established standard (0.02 atm over a 10-day period.)

3.3.3. Cables must not have dents or nicks, nor should they be twisted. In places where they turn, there should be no wrinkles sideways.

3.3.4. When there are a number of cables in the same trench, they must not be crossed. In a two-cable system, cable "A" should be to the right of cable "B," facing away from the higher main station.

3.3.5. When two or more armored cables are in the same trench, they may be laid together, but a plate giving the cable number must be put under the bolts fastening the iron sleeves. In a two-cable communications

system, it is forbidden to lay bare cable running in the opposite direction in the same channel.

The sleeves on underground cables must have a facing 0.5 m to the field side of the cable run.

3.3.6 Interurban telegraph and telephone communications cable must conform to electrical standards in effect with regard to direct and alternating current as established by departmental technical specifications (VTU-175, Appendix 2). Load-coil spacing for cable lines (including half spaces) must be within the limits of the established standards.

3.3.7 Cables laid directly in the ground or in conduits must be protected from all kinds of corrosion and from lightning shock in conformance with the manuals and instructions of the Ministry of Communications in effect (Chapter IV).

3.3.8 There must be control-measuring points along a cable run in order to facilitate periodic measurements of the cable sheathing to ground potential.

3.3.9. All interurban communications line cable, as well as radio cables and lead-in cables, with a length greater than 1 km must be kept under constant excess air (gas) pressure and must be equipped with special control-signaling devices.

Note. An exception to this rule is permitted upon authorization by the GUMTTS or the Ministries of Communications of the Union Republics for each particular case.

3.3.10. Technical documentation must be drawn up for all interurban telephone and telegraph communications lines on forms as required by the Ministry of Communications USSR.

Section 4. Cable facilities, fittings, and auxiliary equipment.

a) Conduit facilities and cables in conduits.

3.4.1. Telephone conduits (ducts and manholes) must conform to the technical specifications in effect for line facilities in urban telephone networks.

3.4.2. Manholes for telephone conduits must have dimensions which conform to the number of channels entering them:

--up to 6 channels for the small type;

--from 7 to 12 channels for the medium type;

--from 12 to 24 channels for the large type;

--for more than 24 channels, a special type; and in instances where it is impossible to construct a manhole, a standard type.

3.4.3. Manhole cover frames, their lids and sides, must be appropriate in type and rigidity to their location. (In an area of vehicular traffic, they should be of the heavy type and the lid should support 15 tons; in an area where there is only pedestrian traffic, a

light-weight type with a lid which will support a weight of 400 kg may be used.)

3.4.4. Manhole cover frames must be constructed so as to be flush with the surface of the ground or surface covering (asphalt, cobblestone pavement, etc.) and they must have an additional covering with a hasp.

The walls and bottom of the manhole wells must be clean and smooth, the lid and opening covered with plaster; metal parts should be painted and the hasps oiled.

3.4.5. If the water level of the soil is high (higher than the bottom of the manhole well), the wells and ducts must be made waterproof, so that water in the soil cannot enter them.

3.4.6. Main-line and radio cables must be in separate channels, and no other cables are to be laid in these channels.

3.4.7. There must be at least one free channel (an operational spare) for replacing a damaged cable span without interrupting communications for all telephone conduit sectors.

3.4.8. Cables laid in telephone channels in manholes, must be laid as their shape requires on brackets which have a rubberoid covering. Sleeves must be arranged between the brackets; it is forbidden to lay them next to conduit channels. The cables and sleeves must be kept clean and must have number-identifying bands.

3.4.9. On remote powered cable sleeves (and, in the absence of sleeves, on the cables themselves) there must be a danger warning sign, a red arrow.

3.4.10. As a rule, cable sleeves are not permitted in conduit channels.

3.4.11. Cables in manhole wells must not be intersected, and access to free channels must not be blocked off.

3.4.12. When a cable runs across the manhole well with duct banks of similar type on both sides of the well, the numbering system should not change. In interurban cable junctions where there is a huge number of cables, they should be numbered according to their function: KM (main line); TF (telephone); TG (telegraph); KR (radio); KU (institutional). Each group is to have an appropriate number.

b) Stage and terminal cable facilities and fittings.

3.4.13. Cable facilities, fittings, and equipment must be installed and set up in conformance with the rules and regulations in effect for the construction and installation of such facilities, and must be provided with adequate protective devices as required by the regulations in effect for technical safety (rubber covers in huts and vaults, and firm platforms with protected cable supports).

3.4.14. Cable boxes, matching equipment, etc., must insure good insulation and good contact for the cable circuits connected to them. They must not upset the electrical parameters of the cables connected to them, causing them to vary from the established electrical standards.

3.4.15. Metal parts must have an anticorrosion covering (paint, tinning, etc.), and all moving parts and hinges must be oiled.

3.4.16. All jumper connections and lead-out conductors must be made of wire that has moisture-proof insulation.

3.4.17. Terminal and stage equipment must be securely fastened and must have a complete set of parts as required.

3.4.18. For good contact, binding posts must have screws with wide heads and with accurately fitting threads (so that they screw in and out with obvious friction).

Whenever there is no direct wire connection (when binding posts or something similar are not used), hot solder should be used, and this should be made in strict conformance with engineering practice (the composition of the solder, the application of a particular flux, preparation of the place to be soldered, etc.).

3.4.19. Boxes must be provided with a complete set of designator plates and junction loops. The designatore plates must show how the cable pairs are numbered.

3.4.20. The lid of the box is to be screwed down tight. After the butt end of the box is filled with cable fiber, the box is installed on the lead-in cable rack (VKS).

3.4.21. The frames of the VKS racks and the boxes installed on them must be insulated from the ground. But if a remote power cable is used, the frames are grounded by a separate bus.

3.4.22. Setting up and installing cable boxes, cable platforms, and matching equipment on cable supports must be done in conformance with the regulations for the construction and repair of overhead communications lines.

3.4.23. The circuit and equipment of lightning protectors must conform to GOST standards in effect for the protection of communications conductor installations from dangerous voltages and currents arising on the communications line. Protective equipment must be readily accessible for inspection and checking.

3.4.24. The bases of protective gear (fuses and dischargers) must be whole (no cracks), clean, and securely fastened. Their current-carrying parts must not show any signs of oxidation.

3.4.25. The jumper wire assembly in the cable box (PRG--1 x 1.5) must be painted once a year with bituminous or alkaline lacquer, and the cable box with oil paint.

3.4.26. The resistance value for fuses connected to a single telephone circuit must not vary more than 0.1 ohm.

3.4.27. Grounding resistance values for the dischargers in cable boxes installed at the junctions between overhead lines and cables (cable in-leads and cable inserts) are given in the table below.

Specific ground resistance in ohm-meters	Number of conductors entering cable box						Sea or river crossing for any number of cable cores
	up to 5	6-11	11-20	21-40	41-60	more than 60	
Up to 50 (chernozem, peat)	12	9	7	6	5	4	5
50-100 (clay and loam)	14	10	8	7	6	5	6
100-300 (sandy loam)	17	13	10	9	7	6	7
300-500 (sand)	24	18	14	12	10	8	10
500-1,000 (rocky)	30	22	17	15	12	10	12

3.4.28. Cable boxes, drainage and choke coils, autotransformers, and coil loading sets must conform to VTU requirements.

3.4.29. Cable equipment must be so placed and so designed that it will be possible for servicing personnel to have free access to it at any time of the day.

3.4.30. The doors to cable vaults, huts, cabinets, and boxes must be of metal and have locks with two sets of keys.

3.4.31. Cable cabinets must be firmly fastened to cabinet boxes and must be accurately positioned in a vertical position. Deflecting plates must be set up on the top part of the cabinets.

Cable cabinets and boxes are equipped with two metal doors the inner of which must have a rubber lining and must be tightly closed so that no dust or moisture can get in. The bottom of the cabinet at the place where cables enter is filled with a bituminous substance, type MKS-3.

3.4.32. The dimensions of the huts and vaults are determined by the volume of the equipment contained in them, allowing for enough room to make all necessary work on them possible.

3.4.33. In the lower (underground) part of a hut or valut, there must be placed an intake chamber for deploying junction sleeves, multiple cable joints, gas-tight sleeves, etc. (the hatch leading into the chamber must be set inside the hut or vault).

3.4.34. Cable huts, vaults, boxes, cabinets, etc., which are set up in the open air, must be made of fireproof materials (brick, concrete, metal) and must protect the equipment inside them from moisture and dust.

3.4.35. The openings for lead-out conductors must not allow moisture to penetrate into the hut, and they must be equipped with porcelain funnels or bushings in order to insulate the walls of the hut from the outgoing conductors.

Ventilating openings should be so placed as to provide for natural ventilation of the hut or vault area, but they should not permit moisture to penetrate inside.

3.4.36. For preventing a moisture rise in the spaces in the huts or vaults, they should be set up in places where the ground water level is low (lower than the bottom of the shaft, or cable housing) and, in addition, the bottom and walls of the shaft must in all cases be made waterproof.

c) Sleeves, loading coil cases, and attenuation networks.

3.4.37. Lead junction sleeves for cables laid in the ground must be protected by iron sleeves with all the necessary reinforcing parts. The iron sleeves must be filled and the fastening bolts covered with bitumen.

3.4.38. Sleeves, loading coil cases, and attenuation networks must not be placed in places that are difficult to get to (in the beds of small rivers and streams, under railroad tracks, in conduit spans, and under other underground facilities), nor closer than 0.5 m to each other in troughs.

3.4.39. Loading coil cases must be hermetically sealed. The iron casing of the loading coil cases and attenuation networks must be filled with bitumen and must be painted on the outside with an anti-corrosion paint.

3.4.40. When there are two or more loading coil cases in a trench, lead tags showing the type and number of the cable must be attached to each of them.

3.4.41. Loading coil cases must be placed so that the opening for a cable will be 5 cm above the level on which the cable is laid. Cable must be laid out along the side of the run just as is done when setting up ordinary junction sleeves.

When the ground is not solid (marshes and quicksand), loading coil cases must be set on foundations or on plates.

Note. The same requirements are made for attenuation networks mounted on the frames of loading coil cases as are made for cases containing loading coils.

3.4.42. Gas-tight sleeves for keeping a cable under temporary or permanent pressure must be set up in conformance with the regulations for the construction of interurban communications cable lines.

CHAPTER 4

PROTECTION FOR CABLES

4.1. All cable lines for interurban telephone and telegraph communications and radio cables must be protected from all kinds of corrosion, from lightning, and from the effects of power transmission lines.

4.2. Protection for cable lines from corrison, lightning, and the effects of power transmission lines must be assured in conformance with Rukovodstvo po zashchite podzemnykh kabeley svyazi ot korrozii [Regulations for the Protection of Underground Communication Cables from Corrosion], Vremennaya instruktsiya po zashchite mezhdugorodnykh kabeley svyazi ot udarov molnii [Temporary Instructions for the Protection of Interurban Communications Cables from Lightning], and Pravilyograzhdeniya sooruzheniy svyazi i signalizatsii ot vrednogo deystviya ustanovok sil'nogo toka [Regulations for Guarding Communications and Signal Facilities from the Harmful Effect of High Current Equipment].

4.3. Cable lines of interurban telephone and telegraph communications and radio cables laid in a single trench or in a single conduit with urban telephone network cables are to be protected from the corroison caused by stray currents along with cables of the urban network.

Inspection of the effectiveness of such protection is to be performed once a year by the organization using the cable line.

4.4. In cities where there are interdepartmental commissions for the protection of underground facilities from corrosion, the organizations which use the cable lines of interurban telephone and telegraph communications must help in the work of these commissions.

4.5. The responsibility for the timeliness, thoroughness, correctness, and effectiveness of the measures for the protection of interurban telephone and telegraph communications cable lines and radio cables from corrosion, lightning, and from the harmful effects of high-current equipment rests with the chief engineers of main-line cable administrations and oblast communications administrations (enterprises).

Development, appropriate measures, and control over the condition of the protection of cable main lines are the responsibility of laboratories of the UKM and of instrument groups of the RKM (MKU); and in line technical centers, the responsibility of the technician or engineer specially chosen for this purpose by order of an enterprise.

4.6. The operations concerned with protecting interurban telephone and telegraph communications lines from lightning which are to be carried out on parallel overhead communications lines (remote ground and spark gap equipment, etc.) are to be carried out by the labor forces of the owners of the overhead line at the expense of the owner of the cable line.

CHAPTER 5

TECHNICAL EQUIPMENT

Section 1. General regulations.

5.1.1. Organizations using cable lines for interurban telephone and telegraph communications must be equipped with transportation facilities, machinery, measuring equipment, instruments, and literature with tables and standards as authorized by the Ministry of Communications USSR in quantity sufficient for carrying out technical supervision, running maintenance, heavy repair, and damage-repair operations.

5.1.2. Materials, fuel, and tools are to be dispensed according to standards approved by the Ministry of Communications USSR for each type of work and are to be written off in the authorized manner.

5.1.3. Responsibility for getting together vehicular transportation, measuring equipment, tools, and materials, as well as their maintenance, proper use, and distribution, in accordance with standard practice, is to be borne by the chief of an enterprise for the enterprise as a whole and by the chiefs of the KU and the UP for their sectors and brigades.

5.1.4. Tables showing how organizations using cable lines for interurban telephone and telegraph communications are to be equipped with vehicles, machinery, and other gear are appended to these Regulations (Appendix 5).

5.1.5. Workshops for performing repair work on vehicles, machinery, cable equipment, station installations, inventory, and tools, as provided for in the nomenclature lists authorized by the chief of the administration for cable main lines (UKM), are to be incorporated into the UKM establishments and their rayons (RKM).

5.1.6. At subsidiary points of the UKM, RKM, MKU, and KU there must be adequate quarters for servicing personnel; warehouses for materials and tools, fuel and oil supplies; garages for vehicle-repair facilities and machinery.

Section 2. Transport and machinery.

5.2.1. Vehicles which are assigned to organizations using cable lines for interurban telephone and telegraph communications are designated as follows:

a) passenger cars for duty trips by managerial personnel to places where disruptions have taken place; for trips to cable runs by administrative and technical personnel for the purpose of checking on the work at amplification points, at cable sectors, and of repair and reinstallation

brigades; and for investigation trips for the purpose of making a decision regarding technical problems based on information obtained at the site;

b) trucks for hauling materials required in the operational, technical, and organizational servicing of main lines and for the repair of line-cable facilities;

c) emergency repair cars for taking repair and installation brigades (RVB) to sites where damage to line cable facilities has occurred. These cars must have a special heated body, comfortable seats, the equipment required for resting and feeding work brigades at the site, as well as the necessary equipment and facilities for storing tools, materials, and a reserve of flexible cable;

d) special cars for providing for operational and emergency technical operations and communications cable lines (movable instrument laboratories, electric power units, power cranes, compressors, etc.).

5.2.2. It is strictly forbidden to use an emergency service automobile for anything other than directly related work.

5.2.3. The vehicle pool must always be ready for trips at a moment's notice, and must always be supplied with reserve fuel and lubricants.

5.2.4. There must be vehicles available which can get through in the face of all kinds of road conditions, tractors, or horse-drawn transport in order to keep line cable organizations operating along the runs in places where because of local conditions it might be difficult for cars or trucks to pass.

5.2.5. For servicing the shore sectors of sea communications cables and cables running across large navigable rivers, there must be adequate floating stock, the quantity and type of which in each instance is determined by the Ministry of Communications USSR or by the ministry of communications of the Union republic, depending on the size and ownership of the facilities.

5.2.6. For supervising the cable runs, sector supervisors must be equipped with bicycles or motorcycles, and with skiis in the wintertime.

Transportation facilities and machinery must be registered in the manner established for them (compressors in a boiler inspection, vehicles in an auto inspection, etc.), and they must pass a technical inspection at the times specified for them. The use of machinery not in good repair is strictly forbidden.

The chief of an enterprise is responsible for the proper use of machinery.

Section 3. Tools and materials.

5.3.1. Cable sectors and repair-replacement brigades must be equipped with tools, materials, and equipment for technical supervision, for preventive maintenance, and for emergency-replacement operations in

quantity adequate for covering and welding no less than three sleeves and for installing no less than two inserts on a cable in operation (Appendix 6).

Tools, materials, and equipment must always be ready for being hauled and for instant use.

5.3.2. A set of those materials and tools frequently called for must be set aside for each brigade (pair) of supervisors-welders. This set of materials and tools must be kept in a special locking portable box. This box must be kept in the storeroom of the KU (RVB) (Appendix 7).

5.3.3. An emergency reserve of cable, the types and dimensions of which are established by the Ministry of Communications USSR, is to be set up for assuring the execution of emergency-replacement operations in a short period of time at enterprises servicing interurban telephone and telegraph communications cable lines and radio cables.

5.3.4. Emergency reserve cable and loading coil cases for rebuilding cable lines must be provided for in the technical plan and must be made available in the proper condition and in duly authorized quantities for use by construction organizations.

5.3.5. Emergency supplies of cables and cases containing inductive coils must be maintained in accordance with instructions for keeping cables (Appendix 8).

5.3.6. Particular attention is to be given to the supply of special equipment and to fire-prevention measures in emergency supply warehouses.

5.3.7. Emergency supply equipment and materials must be kept in an approved manner and in proper working condition so as always to be ready for use without the need for a preliminary check. Moreover, they must be ready for use at any time of the day or night.

5.3.8. If cable lengths are especially long or if road conditions are especially difficult, emergency cable supplies and materials should be distributed along the run in such a way that the time required to deliver them to a place where disruption in operations has occurred may be as short as possible.

5.3.9. Cable drums must be distributed in warehouses so that any drum may be inspected and rolled out of its row with the least possible disturbance of other drums.

In order to facilitate loading the drums for emergency trips, appropriate lifting machinery (power cranes, winches, etc.) should be provided, or else suitably-equipped "mounds," dug-outs, or special platforms are to be provided which will make it possible to load the drums without having to lift them.

5.3.10. In each instance of a disbursement of reserve emergency cable or an inductive coil box, a document is drawn up (in preliminary or final form, depending on the urgency of the work) in which the justification for such disbursement is given. The document is to be approved by the chief of the UKM or oblast communications administration depending on jurisdiction.

5.3.11. Emergency cable supply and basic material supply must be kept up to cover disbursements. The supply of emergency reserves must not fall below established standards for any extended period, and disbursements for unauthorized uses are not permitted.

5.3.12. Materials and emergency supplies for current maintenance operations and for heavy repair for UKM, RKM, MKU, LTU, and KU must be allocated in accordance with standards established by the Ministry of Communications USSR as required by the volume of operations.

The reserve of these materials must cover no less than 3 months' requirements of the RKM, MKU, and LTU and no less than a month's requirements of the KU.

Section 4. Measuring devices.

5.4.1. The UKM, RKM, MKU, KU, and UP must be supplied with measuring equipment, accessories, and power supplies as enumerated in the table (Appendix 9) for purposes of observing the electrical condition of circuits, determining damage spots, determining with great exactness the whereabouts and depth of a cable run, measuring the degree to which cables are protected from corrosion and lightning, checking air pressure in the cable, finding leaks in the lead sheathing, making work safer.

5.4.2. Carrying cases, trunks, and boxes must be made ready for hauling measuring instruments, accessories, and power supply sources. These should also protect the equipment from dampness, should be easy to carry, and, if necessary, should be equipped with shock-absorbing lining or devices for protecting the equipment. Boxes for carrying batteries must have terminal clamps protected from accidental shorts and corks which will not permit the electrolite inside the batteries to splash out when they are being hauled.

5.4.3. Each piece of equipment or set of instruments must have a complete set of flexible leads with a cross section of 2/mm^2 having rubber insulation and, if necessary, suitable shielding for assuring a high degree of insulation and adequate protection from interference when making line measurements.

Wire with untreated outer braiding, flexible cable with cores made of tinsel or steel spirals, wire with a diameter of less than 0.8 mm, as well as wire made up of several splices, are not to be used for connecting measuring instruments together.

5.4.4. The ends of measuring wires must be carefully fixed to plugs or terminal lugs, depending on their intended use.

5.4.5. All measuring instruments which are in use or in an enterprise warehouse must be kept in working order and are to be given a departmental technical inspection at the times determined by the Ministry of Communications USSR.

5.4.6. The departmental inspection of measuring instruments may be performed by state inspection organizations on contract or by a measuring laboratory of the administration for the technical operation of cable main lines; and in oblast communications administrations, by persons designated by the chief of an administration.

The responsibility for the organization and carrying out of departmental inspection rests with the chief engineer of an administration (UKM, or oblast communications administration).

5.4.7. The agency for the inspection of measuring instruments indicated in 5.4.6 must:

a) oversee the use and storage of measuring instruments, make periodic inspections of the equipment, and make certification regarding this:

b) establish communications with agencies checking measuring equipment and see to it that measuring devices are submitted to them for check at the proper intervals;

c) see to it that worn-out, inaccurate, and improperly-used measuring instruments are taken out of service;

d) see to it that schedules are compiled for checking instruments and that these schedules are complied with;

e) keep track of measuring instruments, the demand for them, and compile requisitions;

f) submit reasons to an administration for their redistribution;

g) assure that instrument-repair work is organized;

h) provide for the development of measures designed to improve instruments and methods of control, and for the introduction of the most up-to-date devices and methods of measurement.

5.4.8. In order to keep check on the condition of measuring equipment, on the observance of all instructions and directions of the state or departmental supervisors, chiefs of administrations or enterprises may designate responsible persons (as inspectors) from among senior technicians or engineers, chiefs of instrument groups of the RKM, MKU, and subordinate enterprises.

5.4.9. The departmental supervisory agency and also the responsible inspectors indicated in 5.4.8, in addition to their duties as enumerated above, must see to it that new instruments are carefully checked and that claims regarding poor quality are made to the manufacturers.

5.4.10. Instruments whose accuracy has not been verified by a departmental supervisor or which are not in good working order, may not be used for measuring work.

5.4.11. Measuring instruments may not be turned over by one enterprise to another nor by an element within an enterprise without the knowledge of a departmental supervisor (of a laboratory of the UKM).

5.4.12. Measuring instruments may be written off in a duly authorized manner, but only upon presentation of a departmental supervisory document confirming the unserviceability of the instrument as regards further use or the inadvisability of repairing it.

CHAPTER 6

THE ORGANIZATION OF THE TECHNICAL OPERATION OF INTERURBAN TELEPHONE AND TELEGRAPH CABLE LINES

Section 1. General provisions.

6.1.1. The principal tasks of an enterprise making use of interurban telephone and telegraph cable lines and radio cables are:

a) to provide for uninterrupted and reliable operation of the facilities being serviced;

b) to maintain cable lines, equipment and facilities for them within the terms established by the Ministry of Communications USSR, as well as to work for constant improvement of their condition;

c) to insure the fulfillment of the requirements set forth in the Communications Manual, and in the regulations, rules, handbooks and instructions, orders and directives of the Ministry of Communications USSR regarding the problems concerned with the technical operation of interurban telephone and telegraph cable lines;

d) to raise the productivity of labor, and to reduce monetary, labor, and material expenses for the maintenance of serviced facilities;

e) to introduce modern work methods and to stimulate socialist competition among the workers of an enterprise;

f) to train and increase the number of skilled-worker cadres;

g) to introduce new technology and to develop communication facilities with the maximum utilization of domestic resources;

h) to compile daily reports and technical-use documentation, using the authorized forms for the daily reports regarding the cable facilities of interurban telephone and telegraph communications (album of forms, Svyaz'izdat, 1958) and following the instructions for filling them out.

Section 2. Technical servicing of interurban telephone and telegraph cable lines

6.2.1. For keeping in proper order interurban communications cable lines and radio cables the following are to be performed:

a) preventive maintenance measures, the principal work being directed towards the elimination of disruption in communications activities;

b) routine repair;

c) major repair;

d) replacement operations for removing damaged cables or cable facilities.

6.2.2. The organization and execution of all the enumerated operations are provided for by the administrative and production staff, the interdependence of which is determined by appropriate organizational structures and the quantity of which is determined by staff schedules for standards established by the Ministry of Communications USSR.

6.2.3. Preventive maintenance measures include:

a) technical supervision of the condition of cable runs and supervision of the execution of regulations for the installation and safeguarding of the telephone and telegraph lines of the Ministry of Communications as authorized by the Decree of the Council of Ministers USSR dated 6 February 1946, No. 577;

b) technical supervision of the condition of cable facilities and the performance of preventive maintenance operations;

c) planned and control electrical operations;

d) observation of installations for the protection of cables from corrosion, of the operations of equipment maintaining cables under constant air pressure, and of the activity of various signaling devices;

e) elimination of damaged places on cable lines and facilities before communications activity breaks down.

6.2.4. The principal tasks of technical supervision are:

a) to conduct informative campaigns among the populace and workers of construction organizations, tractor repair and improvement stations, collective and state farms, lumber camps, and especially excavator, bulldozer, and tractor operators, and drivers of similar vehicles, urging them to observe the measures designed to prevent damage to cables when they are working in a cable zone;

b) to inform local agency authorities (oblast, city, and rayon executive committees, village councils, and police agencies, as well as collective and state farms, lumber camps, tractor repair and machine-improvement stations, factories, enterprises, and buildings in the areas of which or near which pass cable runs) concerning the whereabouts of cable runs and concerning regulations for the installation and safeguarding of telephone and telegraph lines of the Ministry of Communications and to control the observance of these regulations;

c) to notify the appropriate organizations and persons concerning the whereabouts of underground cable with a warning regarding responsibility for safeguarding a cable during construction operations;

d) to provide timely renewal of regulations for local governing agencies regarding the guarding of communications lines;

e) to provide for the coordination of all types of earthwork operations in the area of cable runs by planning and construction organizations with those enterprises of the Ministry of Communications servicing cable lines;

f) to instruct construction organizations or individuals in ample time regarding the order to carry out earthwork operations in the area in which cables pass, or regarding the installation of warning signs in areas where operations are being carried out;

g) to provide for continuous control in places where earthwork and construction operations are being performed along cable runs and to provide for reliable protection against damage by machinery to the cables or conduits opened during excavations;

h) to take quick action on measures for preventing cave-ins and for preventing the soil from being washed away along cable runs;

i) to assume responsibility for the condition of cables at river crossings, including a systematic check on the condition of the underwater sections.

Checks on the condition of the shore parts of river crossings are to be made in the summer when the water is at its average level, before floods and ice flows, and before the formation of an ice covering.

j) along with the technical control of the condition of cable runs, to assume responsibility for the condition of measuring posts, control-measurement points, and other cable installations; and for the elimination of errors.

6.2.5. In sectors where cables are laid in conduits, to assume responsibility, along with technical control, for the condition of runs, for the condition of conduit facilities, and for carrying out operations in manhole wells for telephone conduits for the purpose of satisfying the technical requirements regarding the maintenance of conduit facilities and the cables contained in them.

6.2.6. Regular inspections must be carried out and defects removed in order to keep cable facilities, related equipment, safety devices, and connecting and lead-out wires in good working order.

6.2.7. The manner and times for control operations on cable runs, conduit and cable facilities, are set by pertinent instructions and schedules, depending upon local conditions.

6.2.8. All such changes in landmarks located within the boundaries of an area shown on diagrams as are discovered in the course of the technical control activities regarding cable runs and cable facilities, and during the installation of new underground facilities near them, are to be entered in the technical documents.

Changes in the diagrams of cable installations are made simultaneously with the connecting up or plugging in of cables or individual communications facilities.

Section 3. Electrical measurements.

6.3.1. Periodic electrical measurements are to be made with direct and alternating current (planned measurements) for the purpose of bringing to light such changes in the electrical specifications of cable lines and protective devices as may have occurred during use, and for bringing to light as soon as possible such damage as may have occurred.

Planned measurements are made by personnel of the UP and the MTS who service communications cable lines on a schedule set up by the chief engineers of the UKM (oblast communication administrations) based on the following time periods:

a) direct current: twice a year (spring and fall); on the free pairs of cable inserts once a year;

b) alternating current: main-line cables and radio cables. Class I--once every 3 years; all other cables once in 3 to 5 years;

c) tests on coaxial pairs for electrical insulating properties, once in 2 years (summer); and a check on discontinuity, once every 2 years;

d) monitoring measurements on the insulation of Class I and II cables using signal generators are to be made once each shift, otherwise 2 to 4 times each 24-hour period without disrupting communications.

Constant check on the insulation of interurban and radio cables, Class I and II, are to be made using equipment which signals when insulation detxeriorates.

A check on the proper working condition of this signal equipment must be made when the watch officer's shift is on duty at the UP and at radio stations, and a check on the regulating limits for the signal equipment is to be made by the senior technician once every quarter.

6.3.2. Signal equipment instruments must be connected to the center taps on the transformer line coils of simplexed circuits. If there is no circuit of this type, they should be connected to the center taps on transformer line coils; and in the absence of these, to free cores.

6.3.3. As a rule, all cores of the outside lay which are not used for transmitting power or signals are to be connected to the signal equipment device.

6.3.4. The maximum value of insulation which is to actuate the signal equipment is to be set depending on the number of cores connected to the signal equipment and on the type of insulation. This must be done so as to eliminate any possibility of accidently actuating the signal equipment device, and so that there will be ample time to take steps both for measuring to determine the place where insulation value has fallen and to remove the trouble.

6.3.5. The chief (senior technician) of the UP and radio station where the signal equipment is set up is responsible for its proper operation.

6.3.6. A check must be made of the dischargers and grounds in order to assure normal operation of the protective devices against lightning discharges and against the effects of strong current lines.

Dischargers are checked annually before the beginning of the thunderstorm season and after each thunderstorm. Measurements of the resistance of grounds at repeater stations, by cable supports, huts, and vaults, must be done twice a year during a time when the conductivity of the soil is at its lowest point: in summer during dry spells, and in winter when the ground is frozen hardest (GOST 464-51).

6.3.7. All measurements for electrical cable parameters are made during the period of the least use, as required by the regulations and rules and according to the schedules compiled for each cable and coordinated with the chief stations.

6.3.8. All measurements and offers of assistance on the part of stations are to be carried out by technical personnel of the UP or MTS or in coordination with radio stations and radio offices. All measurements on the line or offers of assistance at cable installations are to be carried out by technical personnel of the line service (KU, MKU, RKM, and LTU).

6.3.9. In cases where such changes in parameters turn up in planned measurements as might reflect on the quality of communications, measurements for determining the location of the trouble are to be made at once, and measures taken for removing the trouble.

6.3.10. Records of the measurements are to be forwarded to the chief of the UP (MTS), the radio station (radio office), and are to be analyzed in the RKM, LTU, and MKU. The results of the measurements are to be compared with the established standard norms or with the electrical-history record of the cable. If any changes in the parameters come to light, steps are to be taken to remove the defects.

6.3.11. In addition to planned measurements, the following measurements are also made:

a) measurements to determine the location of trouble spots;

b) monitoring measurements following any installation operations.

Both measurements are made depending on the nature of the trouble and on operations conducted on a particular cable using both direct and, when necessary, alternating current;

c) if there are coaxial pairs, measurements are made with direct current on the dielectric strength of the insulation, and a reading of the pulse response is made.

6.3.12. After repair work has been done on a cable or after trouble spots have been removed, the electrical specifications of this cable line must not be lower than those appearing on the record card for that cable.

6.3.13. Non-planned measurements in each instance are made with the agreement of the operator in charge of the pertinent main station. Planned measurements are made on a schedule arranged with the main station.

Section 4. Measures to protect cables from corrosion.

6.4.1. It is strictly forbidden that cables exposed to corrosion remain without appropriate protection.

6.4.2. Protection from corrosion is provided by:

a) removing the causes of stray currents on the cable sheathing;

b) taking protective measures to eliminate the harmful effects of stray currents and of the cable environment.

6.4.3. The condition of rail and trolley power cables of electrified railroads or similar facilities located near or intersecting cable runs is to be checked in order to determine the causes of stray currents.

This check is to be performed in accordance with technical requirements jointly with the owners of the facilities.

The organizations using cable lines must demand that the owners of the aforementioned facilities remove all trouble sources at once.

6.4.4. In order to expose sources which might cause cable sheathing to corrode, chemical tests are made of the soil or water from those sectors of a run where chemical corroision of a cable is likely to occur; and, when necessary, the place from which the corrosive substance comes is to be determined in order to keep it off the cable. These tests are made in local scientific-research and production chemical laboratories or in the TsNIIS of the Ministry of Communications USSR.

6.4.5. In order to determine the sectors of cable subject to corrosion as quickly as possible, the specific resistance of the soil along all runs must be determined and thorough measurements of the potentials on the cable sheathing and the value of stray currents made.

6.4.6. If the causes of corrosion on cable sheathing cannot be removed, suitable measures must be taken to protect the cable in accordance with the instructions for the protection of cables from corrosion issued by the Ministry of Communications USSR. These are as follows:

a) set up electrical contact between the cable sheath and the device causing stray currents (direct or polarized drainage);

b) feed a negative potential to the cable sheathing in the anode area (installation of a cathode shield or protector);

c) increase the resistance of the cable insulation sheath (installation of electroinsulating sleeves);

d) increase transient resistance between cable sheathing and ground (insulating the cable against water).

6.4.7. The effectiveness of measures carried out for the purpose of protecting cables must be verified by control measurements.

6.4.8. If a run of shielded cable goes parallel to other cables or to metal pipe conduits, such protective measures must be cleared through the organization servicing the other cables or pipe conduits.

6.4.9. The condition of all protected equipment must be regularly checked by outside inspection and by suitable electrical measurements performed in accordance with planned preventive maintenance.

6.4.10. In order to observe stray currents on cable sheathing, control-measurement points must be equipped as required by the Rukovodstvo po zashchite podzemnykh kabeley ot korrozii [Manual for Protecting Underground Cables from Corrosion], and all sheaths with cables laid in a row are to be soldered.

6.4.11. Lead-outs for measuring potentials must be made and cables soldered during the construction of cable lines. Lead-out on existing cable must be made by workers using the lines.

6.4.12. All measures for the protection of cable from corrosion must be carried out in conformance with the afore-mentioned manual, which determines the measures for protection, types and methods of work, as well as times and means for making all measurements and inspections.

If the measures taken in accordance with this manual are of no effect, the TsNIIS should be consulted.

6.4.13. Work done to protect cables from corrosion, control measurements of cable potentials, and other operations are to be done by the KU and LTU under the technical supervision and with the participation of measuring groups of the enterprises concerned. Technical supervision over the selection of methods for protecting cables from corrosion on cable main lines is the responsibility of the UKM laboratory; and on all other cables, of the communications administrations.

6.4.14. Responsibility for maintenance of cable corrosion protection rests with the administration (enterprise) chief engineer.

Note. In enterprises which do not have a chief engineer or a measuring group, operations for protecting cables from corrosion are to be assigned by order to an engineer.

Section 5. Maintaining a cable under constant air pressure.

6.5.1. Maintaining cables under constant air pressure (gas pressure) assures the timely exposure of lead sheathing defects which can cause the cable to lose its seal and which are points where trouble can develop.

6.5.2. Operations for keeping cables under constant air (gas) pressure are to be carried out by the method established by Pravila proizvodstva i priemki rabot po stroitel'stvu mezhdugorodnykh kabel'nykh liniy svyazi [Regulations for the Production of, and Inspection of Work on the Construction of, Interurban Cable Communications Lines].

6.5.3. The amount of air or gas pressure in a cable depends upon the dimension, design, and condition of a cable and is set in each instance within 0.3 to 0.5 atm.

6.5.4. Cables which have been removed and relaid are put under a constant air or gas pressure, the value of which depends on the condition of the sheath. It is permissible to maintain pressure by periodic additions of dry air or gas for providing a pressure of from 0.3 to 0.5 atm.

Air or gas is to be supplied only at repeater stations, cable wells of the MTS, etc. Small electrical comperessors are installed at amplification supply points, and cylinders of compressed air or gas are to be found at supply points.

6.5.5. For drying the air at both places, cylinders with wadding and drying agents must be installed.

The chief of the KU bears responsibility for the timely replacement of the cylinders, and for refilling them with air (gas) and drying agents.

6.5.6. Main-line cable lines must be equipped with control and signal equipment which can notify personnel of a serious drop in pressure and which make it possible to determine the area in which the leak is located.

6.5.7. If the amount of air escaping exceeds a certain value, and if cable pressure falls, the cable sheathing is to be considered damaged. In such a case, measures must be taken to determine and remove the damage as part of routine repair operations.

6.5.8. Operations for determining the location of leaks are performed in two stages:

1) determination of the area of damage, pinning it down to a sector not to exceed 3 km;

2) precise determination of the place of damage and removal of the trouble.

6.5.9. Determination of the area where damage has occurred is done by measuring the pressure along the length of the cable, mapping out schedules for determining excessive cable pressure, and calculating the rapidity at which cable pressure falls at control manometers. For cables under constant pressure equipped with signal devices, the trouble spots are signaled by the actuation of pressure-fall-signaling devices.

6.5.10. Precise determination of the location of trouble spots is done by shooting radioactive gas-forming isotopes or other inert gases and detecting by means of special equipment the point where they flow out into the soil.

6.5.11. Operations for determining the location of a damaged place on sheathing, using radioactive substances, must be done in conformance with the safety regulations and instructions of the Ministry of Communications USSR for determining the location of damage to lead sheathing on interurban communications cables by means of radioactive gas-forming isotopes.

Section 6. Routine and major repair.

6.6.1. For maintaining cables in proper order, operations for routine or major repairs are to be carried out according to a plan which is to be approved every year. In an emergency case, repair is to be performed immediately.

6.6.2. Routine repair is performed every year on all cable runs and cable equipment and is to be carried out by an operational work staff.

6.6.3. The annual plan of operations for routine repair and maintenance is drawn up on the basis of observations of the condition of cable facilities, defects observed during use, and instructions from higher organizations, and is approved by the chief of an enterprise (RKJ, MKU, LTU).

Planning for routine repair operations is done for each such operation.

6.6.4. In routine repair, work is done which does not require a large labor force or much material (planning cable runs; painting measuring posts; plastering and replacing manhole hatches and wells; replacing switching panels and small parts on cable equipment; painting cable boxes, brackets, and supports; checking on the proper condition

of reserve conduit channels; checking on reserve operational cable, the routine repair of signaling devices at river crossings; checking on cable depth in marshes; taking more accurate fixes, etc.).

6.6.5. Operations for guaranteeing normal conditions for cable lines and cable equipment in winter and during floods are also included in the routine repair plan. These are:

a) burying cables more deeply in shore areas;

b) pumping water out of wells;

c) keeping telephone well covers lubricated;

d) supplying proper tools and iachinery (crowbars, wedges, compressors with pneumatic drills, etc.);

e) repairing and supplying winter clothing for line personnel;

f) breaking up ice along the shore near river cable crossing runs;

g) filling the upper covers of telephone wells with bitumen in flooded sectors;

h) supplying emergency cable reserves and light-weight cable of proper length for the quick rerouting of communications in case of cable failure in flooded sectors, and also emergency spares, installation and welding materials, GSM, fuel, and, if necessary, food;

i) supplying line personnel with small craft, water-pumping machinery (motor pumps, etc.), work clothes (rubber boots, raincoats, waterproof suits, etc.), and special transportation for use during spring thaws;

j) during a flood putting cables under temporary air pressure where the cable is not ordinarily under constant air pressure;

k) temporary rerouting using light cables in the absence of spare cable;

l) anticipating operations connected with ice break-up along river cable crossing runs by observing relevant information and by maintaining communications with committees for battling ice flows and floods and with military units; also, setting up observation posts at river crossings;

m) checking on the working order of shore signal equipment and their lighting.

6.6.6. An annual check on measures taken for preparing for winter operations and for operations during floods is to be made in the fall and in the period preceding floods by the managers of enterprises and administrations.

6.6.7. During routine repair work, a check must be made on the conformance of technical documentation to actual operation specifications and all necessary changes made.

6.6.8. The following is performed as major repair operations: replacement of worn-out installations, separate sectors of cable or conduit; rebuilding a well; lying deeper underground cable over a considerable distance; laying cables deeper at river crossings, etc. All these require a great expenditure of labor and materials.

Also included in major repair are the installation of cable under constant air pressure, the inspection by divers of river transits and the installation of equipment to protect cables from corrosion.

Note. The classification of repair and the enumeration of operations have been authorized by order of the Ministry of Communications USSR, dated 25 June 1953, No. 636.

6.6.9. All changes made in operating specifications during major repair work are to be entered in the technical documentation, and, when necessary, the technical documentation is to be written out anew.

6.6.10. Operations connected with such rebuilding of interurban cable communications lines or cable facilities as is necessitated by building and highway construction or modernization and by the construction of railroads and tramways, must be cleared with the UKM (communications administrations). The money and materials are to be supplied by the organizations performing the construction or modernization.

If the amount of work to be done in connection with rebuilding a cable line is small, the operation can be done by the users, but if the operation is large, it is to be done by both the organizations carrying out the construction or modernization and by a specialized construction organization, but under the strict technical supervision of representatives of the KU, RKM, and LTU.

6.6.11. Major repair operations are planned in terms of their volume, the time required to perform them, and their cost. Therefore each operation (title) for major repair must have an estimate with an appendix showing the required technical documentation and a certificate of the damage.

6.6.12. The title list for major repair projects and the estimates must be approved by the chief of the administration (UKM, of the oblast communications administration) or by the Ministry of Communications, depending on the cost of the operation.

6.6.13. Major repair operations may be carried out under contract or by hiring additional workers.

6.6.14. Routine and major repair operations are subject to inspection and are to be drawn up in official documents giving the scope of the operations and an evaluation of their qualities. In the case of major repair, the estimated cost is also to be shown.

Inspection of routine repair operations can be done by a representative of the administration in the enterprise performing the operations; for major repair, by a representative of a superior organization (UKM, communications administration, Ministry ofCommunications of a republic).

6.6.15. Data regarding the execution of routine and major repair operations and their dates are set by the existing statistical report table.

6.6.16. All operations connected with the planned repair of facilities, such as covering sleeves or making new connections at terminal and intermediate installations, may be done only with the authorization of the personnel in charge at the main stations.

Section 7. Repair work.

6.7.1. In all cases of damage to cable or conduit facilities, measures must be taken at once to repair the damage so as not to interrupt communications activities.

6.7.2. Any cable or cable conduit damage which causes a partial or complete breakdown of communications activity is considered an emergency. Measures for taking care of such damage are to be undertaken at once, and the work is to be continued without let-up until the trouble has been entirely eliminated.

6.7.3. An around-the-clock watch by emergency-service overseers equipped with special transportation facilities is set up in the RKM, MKU, and in the LTU located in oblast, kray, and republic (ASSR) centers for the purpose of preventing or eliminating emergency troubles.

6.7.4. In each RKM, MKU, and LTU there must be devised an organization plan for reconstruction operations which should include the following:

a) a schedule providing for communications operations during the transfer of a high-frequency system to a single cable system. The schedule should be cleared with the TsMTS or with the main stations;

b) a system for drafting andnotifying workers of the RKM, RVB, KU, and UP so that they may be available for emergency operations, and so that workers of the UP may be utilized for large-scale emergency operations, along with workers of communications enterprises and the local population and military units;

c) an enumeration of equipment (materials and tools) which are the most necessary for emergency operations with an assignment of each item to specific persons who are to be taken to the site of repair operations;

d) the routes to be used both for picking up people and transporting them in various directions.

6.7.5. When the insulation is destroyed, or when there is some other damage to a cable, the technician in charge at the UP (MTS), radio station (radio bureau), who discovers the damage must immediately:

a) report this to the manager of the interurban telephone station, and with his approval, cut off the remote power supply from the damaged cable, at the same time providing for supply to the good cable in a two-cable system and from the return cable in a single-cable system. To work on a cable which is supplying power to remote points is forbidden.

When there is a clear indication that communications operations may break down, he must see to it that high-frequency systems remain operative over a cable in good condition, in conformance with the schedule for single-cable communications systems;

b) he must initiate measures for the purpose of determining the location of trouble;

c) he must call the chief (senior technician) of the UP radio station to the UP (radio station) and inform the chief of the KU; and he should report to the heads of the RKM, the MKU, and the LTU or the duty

officer of these enterprises (depending on who owns the cable). The chiefs of the RKM, the MKU, and the LTU are to report to higher authority at once.

6.7.6. The chief (senior technician) of the UP, after getting a report from the technician on duty concerning damage to a cable, must immediately go to the UP to assist in reswitching communications, to supply information, and to take steps for removing the trouble as quickly as possible.

6.7.7. The chief of the RKM, the MKU, the LTU, and the KU, after being informed of the cable damage, must make complete preparations for the immediate dispatch of a brigade to the trouble site in conformance with the operational plan while the technical personnel of the UP determine the trouble spot.

The management of technical personnel operations during emergency work on main-line cables, interurban lines, and Class I and II radio cables is assumed by the chief engineer of the UKM or of the communications administration through the chief (senior engineer) of the enterprise (RKM, MKU, or LTU), servicing the cable in question.

6.7.8. The actual work of repairing damage or removing an emergency situation is done principally by the appropriate cable sector whose chief must oversee all operations and who bears the responsibility for the timeliness, completeness, and correctness of measures taken to eliminate the trouble.

6.7.9. In case of an emergency that causes disruption of communications, a second brigade from a neighboring line service base must be sent to speed up the repair work. In addition, the chief (senior engineer) of the RKM, MKU, or LTU must go to the site, and, upon arrival, assume responsibility for all operations.

6.7.10. As a rule, appropriate electrical measurements are made by the personnel on duty at the UP (MTS) or radio station (radio bureau) to determine the location of trouble. These are to be made from both ends of a damaged sector and, if possible, simultaneously.

The execution of repair work without prior measurements at both ends is permitted only when the location of the trouble is known and a sleeve need not be opened.

6.7.11. The station duty technical personnel must be equipped with the necessary circuit diagrams, and instructions for setting up rerouted communications to cover the breakdowns of main cables so as to quickly and smoothly reswitch communications for either single-cable or two-directional circuitry. Station personnel must be equipped with cords ready to be used in reswitching operations.

6.7.12. Each UP or MTS (radio center or radio bureau) must be equipped with the necessary measuring devices in order to perform rapid measurements to determine the location of damage.

6.7.13. Technical personnel of the UP or MTS, radio bureau (radio center), or telegraph office, must know the methods for measurements used to determine the site of damage and must be able to use the

measurement equipment. Technical personnel must hold regular training exercises at least once every quarter in order to insure their facility in making measurements.

In addition to measuring equipment, there must be the required text material (circuit diagrams, instructions for making measurements, tables, coefficients, factory-length registers, etc.).

6.7.14. Measurements to determine the location of damage and control measurements to determine the condition of cable insulation are made from a station by station personnel. Line personnel make precise measurements on the line itself.

6.7.15. A trip by a repair brigade for the purpose of eliminating damage must be made immediately after the results of measurements are known. When the damage to a cable occurs in a sector not in the immediate area nor in the area of assembly for the repair brigade, or in a sector having non-serviced repeater stations (NUP), departure is made immediately to this sector (or to the NUP's in question) without waiting for the results of measurements by remote signal from the NUP.

Note. When information arrives concerning an emergency, a second truck must be made ready in addition to the duty emergency vehicle, and the neighboring sector must also send out a brigade heading for the same point.

6.7.16. The leader of a repair brigade must set up telephone communications with neighboring UP's (of radio stations) and with the person who is in charge of the whole operation as soon as he arrives at the trouble site. Cable pairs are to be used for this purpose, or, if necessary, overhead line circuits.

Telephone communications are to be maintained uninterruptedly until everything is back in order.

6.7.17. The most important task of a repair brigade is to determine the location of damage and to re-establish communications.

6.7.18. If cable repair requires more than 30 minutes before communications can be restored on main multiplex systems, communications are to be set up on a single-cable system or temporarily by installing a flexible cable insert previously provided for this purpose.

6.7.19. If the repair brigade at the site of cable damage determines that communications may continue while repair work is being done, the brigade leader must inform the nearest UP or MTS, radio station or radio bureau, and take steps of a temporary nature to provide communications (laying a light cable around the damaged sector, pumping air into the cable, etc.).

6.7.20. All repair operations on cables or cable facilities are to be done with the agreement of the nearest UP or MTS, radio station or bureau, and communications are to be maintained with them throughout the period of the work. An opened sleeve may be welded shut and departure from a cable facility may be made only with the authorization of the person in charge of emergency operations and after a check has been made of the cable and of communications.

6.7.21. A sleeve may be opened only after power has been cut off, and after an analysis of the results of measurements and a preliminary inspection of the sector on the run contiguous to the place indicated by the measurements and in the absence of any other signs of damage.

The inspection of the contiguous sector is made simultaneously with excavations of a trench for opening up a sleeve.

In case of accidental damage occurring during operations to open a sleeve as determined by the measurement results, trenches at two neighboring sleeves on both sides of the first sleeve are opened.

6.7.22. In the absence of any clear indication of damage after the first sleeve is opened, more accurate measurements at both ends are to be made. No other sleeves may be opened until this is done.

If the results of measurement from the UP or radio station show cable damage running to factory size in length, the two sleeves between which the trouble is assumed to lie are simultaneously opened.

6.7.23. In all cases of cable damage or cable equipment damage both with and without communications damage, technical documents in the prescribed form are to be filled out. They are to show an anlysis of the damage so that measures can be worked out for eliminating the causes of cable damage.

Section 8. Technical documentation.

6.8.1. Technical documentation for a cable that has been laid and a cable that has been assembled must assure the following:

a) an accurate scale reproduction of the site showing the location of any point of the run; any sleeve, conduit, and well of cable systems; facilities for protecting a cable from corrosion and lightning; and the locations of lead-outs for measuring potentials on cable sheathing;

b) the possibility of quickly determining the distance from the repeater station to any sleeve;

c) the possibility of determining accurately the location of each cable core and shield at terminal and intermediate installations;

d) complete electrical specifications for a cable;

e) data on the installation of a cable and its terminal layout;

f) similar data on the cable design.

6.8.2. Documents for cable mainlines are compiled in accordance with Pravila po stroitel'stvu mezhdugorodnykh kabel'nykh liniy svyazi [Regulations for the Construction of Interurban Cable Communications Lines] (Svyaz'izdat, 1958).

6.8.3. All drawings for a cable run and cable facilities must be prepared in a clearly defined scale and be drawn to scale.

6.8.4. A cable accepted for use must be provided with technical-execution documentation so that it can be used at once for the purpose for which it was designed in connection with technical inspection, repair work, and electrical measurements.

6.8.5. All technical documents for a repeater station where the cable is led to terminal installations are to be made up together.

6.8.6. Changes occurring in a cable line (or in cable facilities) as a result of repair operations, or because of being reswitched, must be reflected in all copies of the technical documentation. If necessary, the documents should be made out anew.

Work performed without the presentation of technical documentation is not acceptable.

6.8.7. The chief (senior) engineer of an enterprise bears responsibility for the completeness, correctness, and timeliness of changes in technical documentation.

6.8.8. Responsibility for taking care of the documents, for recompiling them, and for making changes in them is vested

a) in the UKM, in the recording group;

b) in the RKM (LTU), in the senior technician of the group for recording measurements.

6.8.9. The safekeeping and use of technical documentation in administrations and enterprises must be done in accordance with instructions from the Ministry of Communications.

CHAPTER 7

SAFETY, WORKERS' PROTECTION, and INDUSTRIAL SANITATION

7.1. Operations connected with safety, workers' protection and industrial sanitation in the RKM, the MKU, and LTU are set up in accordance with Polozheniye ob organizatsii raboty po tekhnike bezopasnosti, okhrane truda i promsanitarii na predpriyatiyakh, v stroitel'nykh organizatsiyakh, v oblastnykh (krayevykh, respublikanskikh) predpriyatiyakh svyazi [Regulations Concerning the Organization of Work in Connection with Safety, Workers' Protection, and Industrial Sanitation in Enterprises Construction Organizations, and Oblast (Kray and Republic) Communications Enterprises].

7.2. In conformance with the above-mentioned regulations, the organization of the work in connection with, and the responsibility for the state of, safety, workers' protection, and industrial sanitation rests with the chief and the chief (senior) engineer of an enterprise.

When necessary, an engineer or technician may be assigned to assist the chief or chief (senior) engineer in organizing operations concerned with safety, workers' protection, and industrial sanitation.

7.3. In huts, shops, sectors, UP's, and enterprises, the responsibility for taking measures regarding safety, workers' protection, and industrial sanitation rests with the respective chiefs (KU, UP, RVB, etc.).

7.4. The chiefs and all engineering and technical personnel are guided in all matters concerning safety by the regulations indicated in 7.1, Pravila po tekhnike bezopasnosti pri ustroystve i ekspluatatsii mezhdugorodnykh i gorodskikh kabel'nykh liniy svyazi [Regulations on Safety in the Installation and Use of Interurban and Civil Cable Communications Lines], Instruktsiya o poryadke obucheniya rabotnikov svyazi bezopasnym metodam raboty i proverki znaniy pravil tekhniki bezopasnosti [Instructions on Methods for Indoctrination Communications Workers in Safety Methods and for checking on Their Knowledge of the Rules of Safety], Instruktsiya o pravilakh raboty na kabelyakh s distantsionnym pitaniyem [Instructions on Rules for Working on Cables with Remote Power Sources], as amended and also by appropriate orders and regulations of the Ministry of Communications USSR and by the Ministries of Communications of the Union Republics.

7.5. All managers, engineers-technicians, production workers, and subordinate workers of the RKM, MKU, LTU, and KU must be indoctrinated in safe work methods and must be tested annually on their knowledge of the rules of safety.

7.6. All workers who have successfully passed a safety examination are issued a certificate which indicates they have a satisfactory knowledge of safety and may work without supervision.

Permission to work without supervision without this certificate is forbidden.

7.7. In operations using radioactive substances to determine the location of leaks in a cable and when these substances are being transported, the safety measures set forth in Vremennaya instruktsiya o bezopasnykh metodakh raboty pri primenenii radioaktivnykh veshchestv-radona i broma-82 (v vide bromistogo metalla) dlya opredeleniya mesta povrezhdeniya svintsovoy obolochki kabelya [Temporary Instructions Concerning Safe Methods in the Use of Radioactive Substances (Radon and Bromine-82 in the Form of Metal Bromide) for determining the Location of Damage to Lead Cable Sheathing] must be applied.

CHAPTER 8

CHECKING THE OPERATIONAL AND TECHNICAL ACTIVITY OF AN ENTERPRISE, HIRING, PROCEDURES, AND THE TECHNICAL KNOWLEDGE OF THE WORKERS

8.1. In order to check operational and technical activities, the actual condition of an organization, work organization, the accuracy of initial accounting and reporting; and also to expose shortcomings and render the necessary assistance, a check is made of the production operations of subordinate enterprises by the workers of a superior organization and by specially designated committees.

The frequency for making such checks is set by the organization making the check.

8.2. Financial operations of subordinate enterprises are to be checked as provided for in the directives of the chief bookkeeper of the Ministry of Communications USSR and may be included as part of the check on industrial operations.

8.3. A check is carried out in conformance with existing regulations and Instruktsiya Inspektsii pri Ministre svyazi Soyuza SSR o poryadke provedeniya kompleksnykh proverok predpriyatiy Ministerstva svyazi [Instructions for Inspection by the Minister of Communications USSR of the Conducting of Complex Checks on Enterprises of the Ministry of Communications].

8.4. Each worker engaged in servicing interurban cable communications lines and cable facilities must in the course of a trial period pass a test relating to his job, divided as follows:

a) existing regulations for technical operations;

b) technical minimums as provided for in a qualifying questionnaire;

c) job instructions;

d) safety rules;

e) rules for installing and safeguarding telephone and telephone lines of the Ministry of Communications;

f) the statute concerning discipline and the statute on communications in the USSR.

8.5. Tests are given personally by the chief who has the right to hire and fire, or else are performed by a committee appointed by him.

8.6. Workers who have been accepted must pass a medical examination to determine their physical condition and their capacity for the job for which they are hired.

Workers who are to perform work under hazardous conditions (harmful gases and vapors), such as welders and conduit men, must have periodic medical examinations.

8.7. All workers servicing interurban cable lines and communications facilities must have a certificate of identification with a photograph and the title of their job.

8.8. Periodically (no less than once a year) workers must be checked on their knowledge of technical regulations, instructions relating to their job, rules and instructions regarding the servicing and repair of cable facilities, and regulations regarding safety.

8.9. In order to ensure good work habits and to coordinate activities at the various UP's or MTS's (radio bureau or radio centers), regular training exercises on setting up communications in emergency situations are to be conducted during slack hours.

CHAPTER 9

OPENING AND PUTTING IN OPERATION INTERURBAN COMMUNICATION CABLE LINES

9.1. Newly-built or modernized cable lines and cable facilities are put in operation on a permanent basis (after inspection by a committee) in accordance with an approved plan and estimate, the present regulations for technical operation, the regulations for production and work procedures as regards the construction of interurban communication cable lines, and the regulations for technical safety.

9.2. Cable lines may be opened only if all work set forth in the technical plan and estimate including technical documentation has been done with nothing remaining unfinished, there are no defects, and there has been a check by representatives of the using enterprise responsible for checking on production. Main-line cables may be put in use at repeater stations (if they are in proper condition).

9.3. An inspection committee is established by order of the Minister of Communications USSR, or his deputy, for the purpose of opening cable main-line communications lines, Class I.

For opening interurban cable communications lines in connection with construction (or modernization) operations which are within the quota, there is to be created an inspection committee by order of the chief authorizing the plan for this construction or by the chief of a superior organization.

9.4. Cable lines and separate facilities are regarded as acceptable for operations from the day that the chief who set up the inspection committee approves the certificate of approval.

9.5. A check on unfinished work or on elimination defects noted in the committee's certificate (after equipment has been received and the certificate approved) is made by committees set up by the chief of the administration to whom the operation of the whole project is entrusted.

The certificate of the inspection committee for items in excess of the quota is to be approved by the chief of the branch administration of the Ministry of Communications; and for construction items within the quota, by a chief in the using enterprise to which they belong.

CHAPTER 10

SUPERVISION OF THE NEW CONSTRUCTION OF LINE-CABLE FACILITIES

10.1. The construction of interurban cable lines for telephone and telegraph communications must be done in accord with the plans and estimates approved by the Ministry of Communications USSR (or of the Union Republics) or cleared through them.

10.2. An enterprise which is to service a cable line under construction and which will be the recipient, must set up cable sectors and a staff for the UP's in accordance with the staff standards in effect, must provide technical supervision on the quality of the work done by the construction organization, and must do everything possible to help them.

10.3. When necessary in setting up a new enterprise for the operational and technical servicing of the cable line under construction, technical supervision of the quality of construction is charged, at the discretion of the Ministry of Communications' to the enterprise.

Note. It is forbidden to leave construction organization operations (even when the directors of the project under construction are on hand) without technical supervision by operational officials.

10.4. An enterprise, for purposes of technical supervision, assigns by order its own responsible representatives and notifies the construction organization and management of the project under construction.

10.5. The engineering-technical supervisors chosen for technical superintendence must assure transport at the expense of the enterprise controlling the construction.

10.6. The enterprise and its representatives performing technical supervision of the construction is responsible for the following:

a) it must insure that the construction organization observes the Pravila po stroitel'stvu mezhdugorodnykh kabel'nykh liniy telefonno-telegrafnoy svyazi [Regulations for the Construction of Interurban Cable Lines for Telephone and Telegraph Communications] and the instructions in effect (for the construction, installation, balancing, etc.) approved or recommended by the Ministry of Communications USSR;

b) it must insure scrupulous adherence to the plan and also to authorized additions and changes that have been introduced by the commission of experts upon its investigation;

c) it must insure that the quality of the work performed by the construction organization is high, as well as the quality of the materials used; and that established standards and dimensions are observed, especially when laying underground and underwater cables and conduits;

d) it must check on the completeness and accuracy with which cable lines and conduit facilities are recorded, as well as on the conformance of the executive documents to actuality;

e) it must participate in compiling claim vouchers against factories and suppliers for defective equipment;

f) it must intercede with the Ministry of Communications and must make adjustments with the planning organization for departures from the plan in case of the necessity of changing a decision made in the plan;

g) it must check to see that there is agreement to the plan between the interested organizations; and when such is lacking, it must demand that the planning organization formalize such agreement;

h) it must sign the documents for unforeseen work performed by the construction organization.

10.7. Upon the discovery of defects in construction and installation operations, or of violation of established technical work procedures, standards, or dimensions, the technical supervision representatives are obliged to demand the removal of such defects at once; and if these demands are not met, to report this to the manager of the enterprise, who is to take appropriate measures through higher echelons.

10.8. Upon completion of the construction of cable run sectors, the enterprise which has been responsible for technical supervision can put them in operational and technical use and it must:

a) provide for supervision to insure the safekeeping of the cable line just built until it is put in permanent or test use;

b) check on the electrical condition of the cables and on the hermetic sealing of the sheaths;

c) provide for the inspection of shore safety signals and report to navigation authorities concerning new cable river crossings;

d) insure coordination of operations for the construction of other underground facilities in a restricted cable area and supervise this work.

Note. a) only such cable lines are to be accepted by a construction organization for supervision as are installed along repeater stations in the presence of terminal cable installations, technical documentation for making a record of the run, records of electrical measurements, and cables installed under full air pressure;

b) handing over a cable line for supervision is to be formalized by bilateral documents.

10.9. The enterprise providing supervision of a cable run is to be responsible for protecting cables from damage by construction companies.

10.10. The enterprise which is supervising construction must be provided with a plan and with working drawings for constructing this cable line. In case technical operation does not conform to its requirements, it is to inform the planning organization which submitted the plan for approval.

CHAPTER 11

OPERATION PROCEDURES WHEN RECONSTRUCTING LINE-CABLE FACILITIES

11.1. Operations connected with the reconstruction and modernization of line-cable facilities are performed in accordance with plans and estimates approved by the Ministry of Communications or by the Administration (UKM of Communications), depending upon which one owns the cable line and the amount of capital investment.

11.2. The reconstruction and transfer of cable lines and cable facilities due to new construction, urban modernization, road reconstruction, or the construction of any other surface or underground facilities, are to be carried out in accord with plans which have been coordinated with the owner of the cable line. They are to be paid for by the organizations doing the heavy construction work.

11.3. Work on rebuilding or moving line-cable facilities as indicated in 11.2 is to be carried out either by the communications agencies on a contract basis or by organizations doing the heavy construction work, as required by the technical requirements of the Ministry of Communications and under the technical control of the enterprise in charge of the cable line.

In some cases when the job is small, an enterprise can under the conditions set forth in 11.2 perform such operations using its own resources.

11.4. All operations connected with the rebuilding and modernization of line-cable facilities, without regard to the reasons for such work, must be carried out in accordance with the technical requirements and regulations of the Ministry of Communications in effect at the present time.

11.5. Operations connected with the rebuilding of cable line must be carried out without disrupting the communications on that cable. Continuous activity must be guaranteed by rerouting or by setting up temporary inserts to provide normal operations for the cable line during the work.

11.6. Installation, welding, and all kinds of switching on an active cable must be done only by those using it under the conditions set forth in 11.2 and 11.3, without regard to who does the work of rebuilding the cable line.

11.7. When new construction is undertaken (for example, bridges, overpasses, gas conduits, etc.) which does not reach the restricted zone of a cable, but for which inadequate right-of-way clearances as required by these regulations, are left, the cable line is to be moved over as far as the established clearance way. The cost of this is to be borne by the organization performing the major construction under the conditions stipulated in 11.2 and 11.3.

11.8. All work done by construction organizations in connection with modernization, rebuilding, or moving cable lines must be under the constant technical supervision of the enterprise in charge of the cable line or facility.

11.9. Work involving rebuilding or moving a cable line or its facilities done by a nondepartmental organization must be inspected and approval given in writing by the owner of the cable line. Only after such procedure may it be put into operation.

11.10. Work connected with rebuilding and modernizing a cable line and done according to a plan of the Ministry of Communications or an administration (UKM), must be inspected and approved by a commission named by the person who approved the draft plan.

APPENDIX 1

INTERURBAN CABLE COMMUNICATIONS

Principal types of interurban communications cables and their designations.

The following principal types of cables are in use on the interurban telephone and telegraph network of the USSR:

1. Low-frequency uniform cables with star twist, type TZ (GOST 5008-49).
2. Low-frequency combined cables, type TDS (ST-5-4), single-lay, double-lay, and multi-lay.
3. High-frequency main-line cables with twine-paper insulation (TUK.OMM.505.125).
4. High-frequency main-line cables with twine styrolflex insulation (TUK.OMM.505.095).
5. Coaxial main-line cables (TUK.OMM.505.186).

Low-frequency uniform cables with star twist, type TZ, are used for cabling junctions; for installing circuit inputs for overhead communications lines to stations and repeater stations; for cable patches to overhead lines at river crossings and at intersections with high-voltage lines, highways, railroads, etc.; and for laying connecting lines between telephone junctions, ATS and MTS.

When cables are used for lead-ins, cross-overs, and for other types of communications lines, use may be made of part of the circuits (approximately 25%) for high-frequency telephone systems (V-12, KV-12).

When taking special measures for balancing cables, the number of multiplex circuits can be increased to 50% and more. Multiplex cable circuits for matching with overhead line circuits may be coil loaded (L=0.72 mh, S=80m) if Pupin coil units KPL, KPS, and KPP are used.

Low-frequency combined cables, type TDS, are used for lines connecting a radio bureau with radio center and interurban telephone station equipment. Shielded pairs of these cables are used for transmitting radiograms, while other circuits are used, for the most part, for other types of service communications, signaling, and remote control.

High-frequency main-line cables, type MKS and MK, are used for main lines where from 500 to 1,000 telephone channels for communications will be required in the near future.

When more than 1,000 telephone channels are required and where there is a requirement for setting up a television channel, KM or KMK cable is to be used.

Interurban communications cables are divided into the types shown in Table 1, depending on the type of protective covering:

TABLE 1

CABLE TYPES CLASSIFIED BY COVERING (ARMOR)

Cable types					Types of sheathing, armor and protective covering	Purpose
Uniform twist	Composite cable, low-frequency	Main-line twine-styro-flex insul-ation	Main-line with twine-paper insul-ation	Coaxial and com-posite cables		
TZG TZEG	TDSG	MKSG	MKG	KMG KMKG	In lead sheath without armor (bare)	For laying in conduits
TZB TZEB	TDSB	MKSB	MKB	KMB KMKB	In lead sheathing, armor-ed with two steel strips and with the outside cov-ering made of cable yarn impregnated with bitumen	For laying in the ground when no stretching forces are being exerted on a slope no greater than 45°
TZBG TZEBG	-	MKSBG	MKBG	-	In lead sheathing armor-ed with lead stripping and without outside covering	For laying in the open in collectors or in places where there is danger from fires
TZP TZEP	TDSP	-	-	-	In lead sheathing armor-ed with tightly wound steel wires and with an outside covering of cable yarn	For laying in the ground when there is a possibility that stretching forces may develop, on slopes greater than 45°, when a cable is to be suspended in mines, and when a cable is to be laid in marshes and non-navigable rivers

(Table continued on page 51)

(Table continued from page 50)

Cable types					Types of sheathing, armor and protective covering	Purpose
Uniform twist	Composite cable low-frequency	Main-line twine-styro-flex insul-ation	Main-line with twine-paper insul-ation	Coaxial and com-posite cables		
TZPG TZEPG	-	-	-	-	In lead sheathing armored with tightly-wound wires and without outside covering	For laying in the open in areas where there is danger from fires or where stretching forces are likely to arise
TZK TZEK	TDSK	MKSK	MKK	KMK KMKK	In lead sheathing armored with round galvanized steel wiring and with an outside covering of cable yarn	For laying in water basins with regular shipping or streams

1. LOW-FREQUENCY UNIFORM COMMUNICATIONS CABLES

Uniform cables with star twist, type TZ, are made with a number of quads, as shown in Table 2.

TABLE 2

NUMBER OF STAR QUADS IN TZ CABLES

Cable type	Diameter of cores in mm		
	0,8;09	1,0;1.2	1.4
	Number of quads		
TZG; TZB	3;4;7;12;14 19;24;27;30 37;44;48;52 61;75;80;91 102;108;114	3;4;7;12;14 19;24;27;30 37;44;48;52 61	3;4;7;12;14 19;24;27;30 37
TZEG;TZEB;TZBG; TZEBG;TZP;TZEP; TZPG;TZEPG	3;4;7;12;14 19;24;27;30 37	3;4;7;12;14 19;24;27;30 37	3;4;7;12;14
TZK;TZEK	7;12;14;19;24 27;30;37	3;4;7;12;14 19;24;27;30 37	3;4;7;12;14

Dimensions and weight of uniform types of cable with star twist are given in Tables 3, 4, 5, 6.

2. LOW-FREQUENCY COMPOSITE CABLES

Low-frequency composite cables are divided into single-lay, double-lay, and multi-lay.

The various types of single-lay composite cables and their specifications are given in Tables 7, 8, 9, and 10.

Specifications for double-lay cables are given in Table 11.

TABLE 3

DIMENSIONS AND WEIGHT FOR TYPE TZG CABLES

Number of quads in a cable	Diameter of cores, mm: 0.8 Outside diameter, mm	0.8 Weight, kg/km	0.9 Outside diameter mm	0.9 Weight, kg/km	1.0 Outside diameter, mm	1.0 Weight, kg/km	1.2 Outside diameter, mm	1.2 Weight, kg/km	1.4 Outside diameter, mm	1.4 Weight, kg/km
3	11.8	622	13.0	705	13.4	743	14.5	841	17.8	1128
4	12.8	699	14.2	796	14.7	846	15.8	956	19.6	1357
7	15.1	886	16.8	1082	17.6	1157	19.0	1327	23.7	1875
12	19.8	1374	22.4	1590	23.4	1715	25.4	2073	31.8	2980
14	20.8	1479	23.5	1799	24.4	1938	26.7	2355	33.4	3230
19	23.3	1729	26.3	2105	27.4	2388	29.9	2960	37.7	4120
24	27.3	2274	31.1	2820	32.4	3050	35.3	3761	44.5	5206
27	28.1	2380	31.7	3006	33.0	3258	36.0	3957	45.6	5667
30	29.1	2520	32.9	3120	34.4	3578	37.6	4276	47.5	6010
37	31.6	3000	35.7	3492	37.3	4000	40.8	5073	51.5	7192
44	35.5	3560	40.4	4543	42.1	4942	46.3	6010	-	-
48	36.2	3705	41.0	4705	42.8	5137	47.0	6260	-	-
52	37.4	3870	42.2	4921	44.2	5540	48.3	6747	-	-
61	39.8	4390	45.1	5572	47.1	6081	51.5	7639	-	-
75	44.4	5300	50.8	6822	-	-	-	-	-	-
80	45.4	5666	51.7	7047	-	-	-	-	-	-
91	47.8	6104	54.4	7600	-	-	-	-	-	-
102	51.8	7079	58.9	8765	-	-	-	-	-	-
108	52.7	7280	60.1	9060	-	-	-	-	-	-
114	53.7	7510	61.1	9310	-	-	-	-	-	-

TABLE 4

DIMENSIONS AND WEIGHT FOR TYPE TZB CABLES

Number of quads in a cable	Diameter of cores, mm: 0.8 Outside diameter, mm	0.8 Weight, kg/km	0.9 Outside diameter, mm	0.9 Weight, kg/km	1.0 Outside diameter, mm	1.0 Weight, kg/km	1.2 Outside diameter, mm	1.2 Weight, kg/km	1.4 Outside diameter, mm	1.4 Weight kg/km
3	19.1	1057	20.3	1160	20.7	1340	21.8	1480	25.9	1910
4	20.1	1150	21.5	1410	22.0	1480	23.1	1635	27.5	2220
7	22.4	1550	24.1	1818	25.7	1930	27.1	2152	31.6	2960
12	27.7	2225	30.3	2522	31.2	2680	35.3	3230	41.7	4300
14	28.7	2363	31.4	2777	32.3	3060	36.6	3560	43.3	4609
19	31.2	2695	36.2	3289	37.3	3620	39.8	4230	47.4	5497
24	37.2	3500	41.0	4124	42.3	4400	45.2	5144	54.2	6978
27	38.0	3629	41.6	4273	42.9	4566	46.0	5360	55.3	7330
30	39.0	3801	42.8	4484	44.3	4931	47.3	5660	57.2	7705
37	41.5	4320	45.6	5100	47.0	5466	50.5	6767	61.2	9230
44	45.4	5019	50.1	5770	51.8	6632	56.0	7765	-	-
48	46.1	5188	50.7	6352	52.5	6600	56.7	7940	-	-
52	47.1	5380	51.9	6610	53.9	7130	58.0	8465	-	-
61	49.5	5830	54.8	7167	56.8	7760	61.2	9560	-	-
75	54.1	7075	60.5	8414	-	-	-	-	-	-
80	55.1	7304	61.5	8990	-	-	-	-	-	-
91	57.5	7800	65.1	9812	-	-	-	-	-	-
102	61.5	9200	69.4	10900	-	-	-	-	-	-
108	63.4	9423	70.6	11224	-	-	-	-	-	-
114	64.4	9686	71.6	11523	-	-	-	-	-	-

TABLE 5

DIAMETER AND WEIGHT OF TYPE TZP CABLES

Number of quads in a cable	Diameter of cores, mm: 0.8 Outside diameter, mm	0.8 Weight, kg/km	0.9 Outside diameter, mm	0.9 Weight, kg/km	1.0 Outside diameter, mm	1.0 Weight, kg/km	1.2 Outside diameter, mm	1.2 Weight, kg/km	1.4 Outside diameter, mm	1.4 Weight kg/km
3	20.7	1280	21.9	1380	22.3	1595	23.4	1766	26.9	2300
4	21.7	1400	23.3	1715	23.6	1775	24.9	1955	28.5	2650
7	24.0	1820	25.9	2185	26.7	2275	28.1	2525	32.6	3465
12	28.7	2590	31.3	2950	32.2	3095	36.3	3706	42.7	4950
14	29.7	2765	32.4	3330	33.3	3488	37.6	4070	44.3	5280
19	32.2	3090	37.2	3800	38.3	4120	40.8	4790	-	-
24	38.2	3955	42.0	4720	43.3	4980	46.2	5157	-	-
27	39.0	4170	42.6	4860	43.9	5190	46.9	5985	-	-
30	40.0	4330	43.8	5105	45.3	5590	48.7	6316	-	-
37	42.5	4915	46.6	5970	48.4	6130	51.9	7700	-	-

TABLE 6

DIMENSIONS AND WEIGHT FOR TYPE TZK CABLES

Number of quads in a cable	Diameter of cores, mm									
	0.8		0.9		1.0		1.2		1.4	
	Outside diameter, mm	Weight, kg/km	Outside diameter, mm	Weight, kg/km	Outside diameter, mm	Weight, kg/km	Outside diameter mm	Weight, kg/km	Outside diameter, mm	Weight, kg/km
3	-	-	-	-	31.1	3215	32.2	3534	35.3	4040
4	-	-	-	-	32.4	3490	33.5	3815	37.1	4485
7	32.8	3550	34.5	3880	35.1	4060	36.5	4470	41.0	5730
12	37.3	4580	39.7	5120	40.6	5485	43.7	6110	49.9	7540
14	38.3	4735	40.8	5540	41.7	5825	45.0	6450	51.5	8060
19	40.6	5400	44.6	6180	45.7	6510	58.2	7350	-	-
24	45.6	6420	49.2	7350	50.5	7740	53.4	8570	-	-
27	46.4	6655	49.8	7500	51.1	7900	54.1	8795	-	-
30	47.4	6940	51.0	7825	52.5	8250	59.5	11435	-	-
37	49.7	7560	53.6	8525	59.2	10960	62.7	12590	-	-

TABLE 7

VOLUME, DIMENSIONS, AND WEIGHT OF TYPE TDSG CABLES

Volume of cable, diameter of cores in mm	Outside diameter in mm	Weight of 1 km of cable, in kg
1 X 2 shielded pairs X 1.2+2X(3X2X0.8)	20.5	1220
1 X 2 shielded pairs X 1.4+2X(3X2X0.8)	21.0	1250
2 X 2 shielded pairs X 1.2+1X(3X2X0.8)	20.0	1190
2 X 2 shielded pairs X 1.4+1X(3X2X0.8)	21.0	1250
2 X 2 shielded pairs X 1.2+2X(3X2X0.8)	22.5	1440
2 X 2 shielded pairs X 1.4+2X(3X2X .8)	23.0	1500
3 X 2 shielded pairs X 1.2+1X(3X2X0.8)	22.0	1400
3 X 2 shielded pairs X 1.4+1X(3X2X0.8)	23.0	1500
3 X 2 shielded pairs X 1.2+4X3X2X0.8)	27.5	1940
3 X 2 shielded pairs X 1.4+4X(3X2X0.8)	28.0	2010
4 X 2 shielded pairs X 1.2+3X(3X2X0.8)	27.5	1930
4 X 2 shielded pairs X 1.4+3X(3X2X0.8)	28.0	2010
1 X 2 shielded pairs X 0.9+2X(1X4yX0.8)	15.5	790
2 X 2 shielded pairs X 0.9+1X(1X4yX0.8)	15.5	780
2 X 2 shielded pairs X 0.9+2X(1X4yX0.8)	17.0	880
3 X 2 shielded pairs X 0.9+1X(1X4yX0.8)	17.5	870
4 X 2 shielded pairs X 0.9+3X(1X4yX0.8)	20.5	1260
3 X 2 shielded pairs X 0.9+4X(1X4yX0.8)	20.5	1260

TABLE 8

VOLUME, DIMENSIONS, AND WEIGHT OF TYPE TDSB CABLES

Volume of cable, diameter of cores in mm	Outside diameter in mm	Weight of 1 km of cable, in kg
1 X 2 shielded pairs X 1.2+2X(3X2X0.8)	28.0	1740
1 X 2 shielded pairs X 1.4+2X(3X2X0.8)	28.5	1780
2 X 2 shielded pairs X 1.2+1X(3X2X0.8)	27.5	1700
2 X 2 shielded pairs X 1.4+1X(3X2X0.8)	28.5	1780
2 X 2 shielded pairs X 1.2+2X(3X2X0.8)	31.0	2050
2 X 2 shielded pairs X 1.4+2X(3X2X0.8)	31.5	2130
3 X 2 shielded pairs X 1.2+1X(3X2X0.8)	30.5	2010
3 X 2 shielded pairs X 1.4+1X(3X2X0.8)	31.5	2130
3 X 2 shielded pairs X 1.2+4X(3X2X0.8)	36.0	2650
3 X 2 shielded pairs X 1.4+4X(3X2X0.8)	36.5	2840
4 X 2 shielded pairs X 1.2+3X(3X2X0.8)	36.0	2640
4 X 2 shielded pairs X 1.4+3X(3X2X0.8)	36.5	2840
1 X 2 shielded pairs X 0.9+2X(1X4yX0.8)	23.0	1280

(Table continued on Page 58)

(Table continued from Page 57)

Volume of cable, diameter of cores in mm	Outside diameter in mm	Weight of 1 km of cable, in kg
2 X 2 shielded pairs X 0.2+1X(1X4yX0.8)	23.0	1270
2 X 2 shielded pairs X 0.9+2X(1X4yX0.8)	24.5	1390
3 X 2 shielded pairs X 0.9+1X(1X4yX0.8)	24.5	1380
4 X 2 shielded pairs X 0.9+3X(1X4yX0.8)	28.0	1780
3 X 2 shielded pairs X 0.9+4X(1X4yX0.8)	28.0	1780

TABLE 9

VOLUME, DIMENSIONS, AND WEIGHT OF TYPE TDSP CABLES

Volume of cable, diameter of cores in mm	Outside diameter in mm	Weight of 1 km of cable, in kg
1 X 2 shielded pairs X 1.2+2X(3X2X0.8)	29.0	2170
1 X 2 shielded pairs X 1.4+2X(3X2X0.8)	29.5	2200
2 X 2 shielded pairs X 1.2+1X(3X2X0.8)	28.5	2140
2 X 2 shielded pairs X 1.4+1X(3X2X0.8)	29.5	2200
2 X 2 shielded pairs X 1.2+2X(3X2X0.8)	32.0	2550
2 X 2 shielded pairs X 1.4+2X(3X2X0.8)	32.5	2610
3 X 2 shielded pairs X 1.2+1X(3X2X0.8)	31.5	2510
3 X 2 shielded pairs X 1.4+1X(3X2X0.8)	32.5	2610
3 X 2 shielded pairs X 1.2+4X(3X2X0.8)	37.0	3170
3 X 2 shielded pairs X 1.4+4X(3X2X0.8)	37.5	3400
4 X 2 shielded pairs X 1.2+3X(3X2X0.8)	37.0	3160
4 X 2 shielded pairs X 1.4+3X(3X2X0.8)	37.5	3400
1 X 2 shielded pairs X 0.9+2X(1X4yX0.8)	24.0	1630
2 X 2 shielded pairs X 0.9+1X(1X4yX0.8)	24.0	1620
2 X 2 shielded pairs X 0.9+2X(1X4yX0.8)	25.5	1760
3 X 2 shielded pairs X 0.9+1X(1X4yX0.8)	25.5	1750
4 X 2 shielded pairs X 0.9+3X(1X4yX0.8)	29.0	2210
3 X 2 shielded pairs X 0.9+4X(1X4yX0.8)	29.0	2210

TABLE 10

VOLUME, DIMENSIONS AND WEIGHT OF TDSK CABLES

Volume of cable, diameter of cores in mm	Outside diameter in mm	Weight of 1 km of cable, in kg
1 X 2 shielded pairs X 1.2+2X(3X2X0.8)	36.5	3720
1 X 2 shielded pairs X 1.4+2X(3X2X0.8)	37.0	3860
2 X 2 shielded pairs X 1.2+1X(3X2X0.8)	36.0	3690
2 X 2 shielded pairs X 1.4+1X(3X2X0.8)	37.0	3860
2 X 2 shielded pairs X 1.2+2X(3X2X0.8)	39.5	4240
2 X 2 shielded pairs X 1.4+2X(3X2X0.8)	40.0	4310
3 X 2 shielded pairs X 1.2+1X(3X2X0.8)	39.0	4190
3 X 2 shielded pairs X 1.4+1X(3X2X0.8)	40.0	4310
3 X 2 shielded pairs X 1.2+4X(3X2X0.8)	44.5	5230
3 X 2 shielded pairs X 1.4+4X(3X2X0.8)	45.0	5310
4 X 2 shielded pairs X 1.2+3X(3X2X0.8)	44.5	5220
4 X 2 shielded pairs X 1.4+3X(3X2X0.8)	45.0	5310
1 X 2 shielded pairs X 0.9+2X(1X4yX0.8)	31.5	2900
2 X 2 shielded pairs X 0.9+1X(1X4yX0.8)	31.5	2890
2 X 2 shielded pairs X 0.9+2X(1X4yX0.8)	33.0	3120
3 X 2 shielded pairs X 0.9+1X(1X4yX0.8)	33.0	3110
4 X 2 shielded pairs X 0.9+3X(1X4yX0.8)	36.5	3760
3 X 2 shielded pairs X 0.9+4X(1X4yX0.8)	36.5	3760

TABLE 11

DOUBLE-LAY COMPOSITE CABLES

Number of elements of shielded pairs in center of cable and diameter of cores in mm	Number of elements in outer (second) lay depending on type of twist and diameter of strands			
	1X4X0.8	1X2X0.9	1X2X0.8	1X2X0.9
1 X 2 shielded pairs X 0.9	7	7	9	9
1 X 2 shielded pairs X 1.0	8	8	10	10
1 X 2 shielded pairs X 1.2	9	9	11	10
1 X 2 shielded pairs X 1.4	9	9	11	10
2 X 2 shielded pairs X 0.9	11	11	13	13
2 X 2 shielded pairs X 1.0	13	13	15	15

(Table continued on Page 60)

(Table continued from Page 59)

Number of elements of shielded pairs in center of cable and diameter of cores in mm	Number of elements in outer (second) lay depending on type of twist and diameter of strands			
	1X4X0.8	1X2X0.9	1X2X0.8	1X2X0.9
2 X 2 shielded pairs X 1.2	14	14	16	16
2 X 2 shielded pairs X 1.4	15	14	17	16
3 X 2 shielded pairs X 0.9	12	12	14	13
3 X 2 shielded pairs X 1.0	14	13	16	15
3 X 2 shielded pairs X 1.2	15	14	17	16
3 X 2 shielded pairs X 1.4	15	15	18	17
4 X 2 shielded pairs X 0.9	12	12	16	15
4 X 2 shielded pairs X 1.0	14	14	19	18
4 X 2 shielded pairs X 1.2	15	15	20	19
4 X 2 shielded pairs X 1.4	16	15	21	20

Multi-lay composite cables are made in the following types:

7 X 2 shielded pairs X 1.4+20 X 4 X 0.9
14 X 2 " " X 1.4+25 X 4 X 0.9

Principal electrical characteristics of low-frequency cables.

The principal electrical characteristics of low-frequency cables for direct current and the rated volume of the cable are given in Table 12.

TABLE 12

PRINCIPAL CHARACTERISTICS FOR TZ AND TDS CABLES AT t=20° C

Characteristic	Diameter of cores in mm				
	0.8	0.9	1.0	1.2	1.4
1. Resistance of a single core in ohms	36.1	28.5	23.5	16.4	11.9
2. Resistance of insulation on core with respect to rest of insulation connected to sheathing, in megohms	10,000	10,000	10,000	10,000	10,000
3. Electrical break-down point of insulation under 2-minute tests, a.c. (50 cps), effective volts					
a) between cores	700	700	1,000	1,000	1,000
b) between cores and shield connected to lead sheathing	1,000	1,000	1,800	1,800	1,800
c) between cores and lead sheathing	1,800	1,800	1,800	1,800	1,800
4. Rated capacitance of TDS cable circuits, in nf per km, not more than:					
a) non-shielded	35			36	
b) shielded	36			38	
Same, for TZ cables					
a) non-shielded			30-36		
b) shielded			33-38		

Basic parameters for TZ cables carrying alternating current are given in Table 13.

TABLE 13

BASIC PARAMETERS FOR TZ CABLES CARRYING A. C.

Freq. in kc	dia=0.8 mm C=33 nf/km				dia=0.9 mm C=33.5 nf/km				dia=1 mm C=34 nf/km			
	millinepers/km	rad/km	Z ohms	Z	millinepers/km	rad/km	Z ohms	Z	millinepers/km	rad/km	Z ohms	Z
0.3	46.1	0,050	1058	44°	40.0	0,042	923	44°	37.2	0,0387	830	44°
0.8	73.5	0,079	648	43°	66.0	0,069	588	43°	59.2	0,0638	510	43°
10	202.0	0,360	200	29°	170.0	0,345	192	26°	145.0	0,306	135	23°
30	251.0	0,940	156	15°	220.0	0,940	150	13°	188.0	0,947	147	11°
60	307.0	1,830	147	9°	275.0	1,84	146	8°	240.0	1,845	144	7°
150	468.0	4,520	145	5°	429.0	4,560	144	5°	391.0	4,590	143	4°

(Table continued on Page 63)

(Table continued from Page 62)

Freq. in kc	dia=1.2 mm C=34.5 nf/km				dia=1.4 mm C=35.5 nf/km			
	β millinepers/km	α rad/km	Z ohms	φ Z	β millinepers/km	α rad/km	Z ohms	φ Z
0.3	31.1	0,0324	688	44°	26.9	0,0282	596	43°
0.8	49.5	0,0553	424	42°	43.1	0,0494	366	41°
10	107.0	0,337	158	19°	91.3	0,313	147	16°
30	150.0	0,950	144	8°	129.0	0,904	136	8°
60	200.0	1,870	142	6°	185.0	1,810	132	5°
150	325.0	4,620	142	4°	319.0	4,320	129	3°

Parameters for shielded pair circuits are given in Table 14.

TABLE 14

PARAMETERS FOR NON-COIL LOADED SHIELDED PAIRS WITH A DIAMETER OF 1.4 MM

Freq. kc	β millinepers/ km	α rad/km	Z ohms	φ_z	Z cos φ_z ohms	-Zsin φ_z ohms
0.3	27.8	0,0291	562	43°	408	386
0.8	43.6	0,0494	345	41°	260	227
10	95.0	0,312	135	16°	129	37.8
30	130.0	0,906	128	7°	127	15.5
60	186.0	1,800	126	5°	126	10.1
150	360.0	4,490	126	3°	126	5.6

Parameters for shielded pair circuits are given in Table 15.

TABLE 15

PARAMETERS FOR COIL-LOADED SHIELDED PAIRS
d = 1.4 mm, L_s = 12 millihenries, S = 1.7 km

Freq. kc	β millinepers/ km	α rad/km	Z ohms	- φ_z	Z cos φ ohms	-Zsin φ ohms
0.05	11.8	0,0088	1400	41°	1046	930
0.1	14.8	0,0143	1082	40°	834	692
0.3	21.7	0,0346	750	29°	582	353
0.5	24.2	0,055	555	23°	513	215
0.8	26.0	0,085	526	17°	485	187
2.4	27.5	0,248	488	6°	476	56
5.0	28.9	0,514	519	4°	519	32
7.0	30.2	0,748	590	3°	590	33
8.0	31.8	0,900	657	3°	657	35
10.0	42	1,220	974	4°	974	76

Parameters having influence on low-frequency communications cables.

In composite cables crosstalk attenuation should be:

--between any non-shielded circuits, not less than 8.0 nep;

--between shielded circuits of different groups, no less than 11.0 nep.

Instead of measuring crosstalk attenuation, a measurement of the communication coefficient can be made. The standards for the coefficient of communication in factory lengths are given in Table 16.

TABLE 16

COEFFICIENTS OF COMMUNICATION CAPACITANCE IN LOW-FREQUENCY CABLES

Coefficient designation	Between circuits	Average value, in micromicrofarads		Maximum value, in micromicrofarads
		TZ cable	TDS cable	
K_1	Between basic circuits of quads or sixes	$75\sqrt{\frac{L}{425}}$	$40\ \frac{L}{230}$	$280\ \frac{L}{425}$
K_9, K_{10}, K_{11}, K_{12}	Between basic circuits of quads and sixes lying together			
	a) non-shielded	$110\sqrt{\frac{L}{425}}$	$60\ \frac{L}{230}$	$420\ \frac{L}{425}$
	b) shielded	$10\sqrt{\frac{L}{425}}$	-	$20\ \frac{L}{425}$
e_1;e_2	For basic circuits	$280\ \frac{L}{425}$	$150\ \frac{L}{230}$	$1100\ \frac{L}{425}$

3. HIGH-FREQUENCY MAIN-LINE CABLES WITH TWINE-PAPER INSULATION

High-frequency cables for main-line communications having twine-paper insulation are made for multiplexing in a frequency spectrum to 108 kc (MK-24) and to 252 kc (MK-60), and with twine-styroflex for multiplexing in a frequency spectrum to 108 kc (MKS-24), 252 kc (MKS-60), and 800 kc (MKS-180).

MK-24 and MKS-24 cables are designed for multiplex 24-channel systems of the K-24, MK-60; the MKS-60 is for the 60-channel, K-60; and the MKS-180 is for the 180-channel system, the K-180.

Cables having twine-paper insulation are divided according to their design and to the number of quads into uniform 4-quad, 7-quad, and composite 13-pair, 23-pair, and 32-pair.

Cables having twine-stryoflex insulation are made with a uniform twist as 4-quad and 7-quad.

In addition to the principal elements (star quads and shielded pairs), high-frequency cables contain, as a rule, signal cores with a diameter of 0.9 to 1.0 mm.

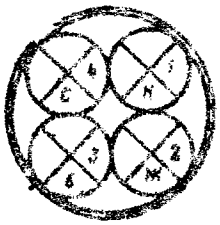
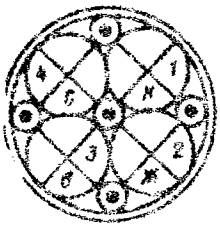
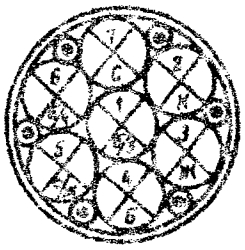
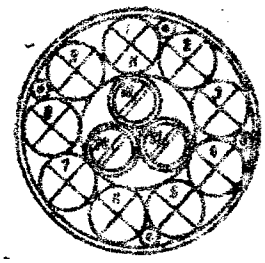
4-quad	-5 cores
7-quad	-6 cores
23-pair	-4 cores
32-pair	-2 cores

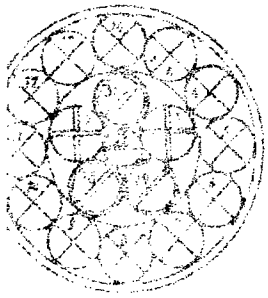
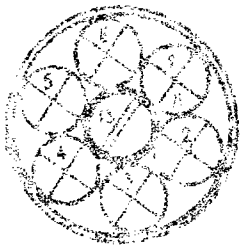
The 4 x 4 and 7 x 4 cables which were made in the past do not have signal cores.

Data concerning the design, dimensions, and weight of high-frequency cables with twine-paper insulation, type MK, are given in Table 17.

TABLE 17

DESIGN, DIMENSIONS, AND WEIGHT OF MKG, MKB, AND MKK CABLES

Cross-section of cable	Type of cable	Number of twist elements	Diameter through lead, mm	Outside diameter, mm	Weight of 1 km of cable kg	Factory length, m
	MKG	4X4X1.2	23.2	23.2	1556	850+ +10 ~ or
	MKB	4X4X1.2	23.0	31.0	2455	
	MKK	4X4X1.2	24.3	40.3	5257	429± 4
	MKG	4X4X1.2+ +5X1X0.9	23.2	23.2	1596	Same
	MKB	4X4X1.2+ +5X1X0.9	23.0	31.0	2501	"
	MKK	4X4X1.2+ +5X1X0.9	24.3	40.3	5304	"
	MKG	7X4X1.2+ +6X1X0.9	28.3	28.3	2277	"
	MKB	7X4X1.2+ +6X1X0.9	27.9	37.9	3293	"
	MKK	7X4X1.2+ +6X1X0.9	29.3	45.3	6596	"
	MKG	23X2(9X4X X1.2+3 X X2 shielded X1.4+ +4X1X0.9)	43.7	43.7	4485	429± 4
	MKB	23X2	43.1	53.0	6005	429± 4
	MKK	23X2	44.1	65.1	12649	429± 4

Cross-section of cable	Type of cable	Number of twist elements	Diameter through lead, mm	Outside diameter, mm	Weight of 1 km of cable kg	Factory length, m
	MKG	32X2 (1ЖX ЖЖX1.2+3Ж Ж2 shielded Ж1.4 + +1X2Ж0.9)	44.0	44.0	5900	429± 4
	MKB	32X2	43.5	43.5	5200	
	MKK	32Ж2	44.4	64.4	16900	
	MKG	13X2(6ЖX X1.2+1Ж Ж2 shielded Ж1.4)	28.3	28.3	2277	450± ±10

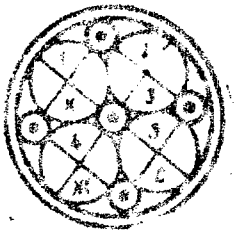
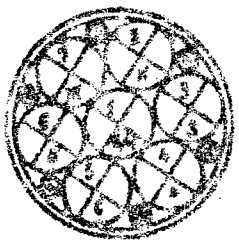
Note: Key to above table and those following:
c= blue
k= red
Ж= yellow
б = white
y= black.

4. HIGH-FREQUENCY MAIN-LINE CABLES WITH TWINE-STYROFLEX INSULATION

Data on the design, dimensions, and weight of high-frequency cables with twine-styroflex insulation are given in Table 18.

TABLE 18

DESIGN, DIMENSIONS, AND WEIGHT OF MKSG, MKSB, AND MKSK CABLES

Cross-section of cable	Type of cable	Number of twist elements	Diameter through lead, mm	Outside diameter, mm	Weight of 1 km of cable kg	Factory length, m
	MKSG	4X4X1.2 +5X0.9-24	19.2	19.2	1163.7	500 or 650
	MKSB	4X4X1.2+ +5X0.9-24	18.9	27.9	1835	
	MKSK	4X4X1.2+ +5X0.9-24	19.2	35.2	3990	
	MKSG	4X4X1.2+ +5X0.9-60	19.6	19.6	1201	500
	MKSB	4X4X1.2+ 5X0.9-60	19.3	28.3	1878	
	MKSK	4X4X1.2+ +5X0.9-60	19.6	35.6	4136	
	MKSG	7X4X1.2+ +5X0.9-24	23.6	23.6	1510	500
	MKSB	7X4X1.2+ +6X0.9-24	23.3	32.3	2299	
	MKSK	7X4X1.2+ +6X0.9-24	23.6	39.0	4967	
	MKSG	7X4X1.2+ +5X0.9-60	24.0	24.0	1546	500
	MKSB	7X4X1.7+ +5X0.9-60	23.7	32.7	3345	
	MKSK	7X4X1.2+ +5X0.9-60	24.0	40.0	4911	

Cables may not have signal cores.

For very active soil conditions, MKSBv cables may be made with a protective covering of two polyvinyl chloride strips attached to the lead sheathing with a final covering of armor.

The electrical specifications for factory lengths of cable with twine-paper insulation, type MK and MKS, are given in Tables 19 and 20.

TABLE 19

ELECTRICAL SPECIFICATIONS FOR HIGH-FREQUENCY CIRCUITS IN FACTORY LENGTHS FOR MK AND MKS CABLES ("STAR", TWIST DIAMETER OF CORES 1.2 mm)

Characteristic	Frequency, kc	Unit of measure	Numerical value For MKB cables l=850 m	Numerical value For MKSB cables l=500 m	Coefficient of converting to another length
1. Resistance of pair of cores for d.c. not greater than	d.c.	ohm	31.9	31.9	$\frac{\ell}{1000}$
2. Difference of resistance of cores in one pair not greater than	d.c.	ohm	0.17	0.15	$\sqrt{\frac{\ell}{850}}$
3. Resistance of insulation on cores not less than	"	megohm	10,000	10,000	$\frac{1000}{\ell}$
4. Rated capacitance a) nominal value for basic circuits not greater than	0.8	nf/km	27.0	$\frac{25}{24.0}$	$\frac{\ell}{1000}$
b) permissible deviation from nominal value for MK-60, MKS-60, and MKS-180 (K-180) cables	"	"	$\pm$1.0	$\pm$0.8	$\frac{\ell}{1000}$
c) permissible deviation from nominal for MK-24 cables	nf/km	"	$\pm$1.1	-	$\frac{\ell}{1000}$

(Table continued on Page 71)

(Table continued from Page 70)

Characteristic	Frequency, kc	Unit of measure	Numerical value For MKB cables l = 850 m	Numerical value For MKSB cables l = 500 m	Coefficient of converting to another length
5. Crosstalk attenuation at near end between circuits of one or several quads not less than	800	nep	-	6.8	$-\frac{1}{2}in\ \frac{l}{850}$
	250	nep	6.8	6.8	
	100	nep	6.8	-	$-\frac{1}{2}in\ \frac{l}{500}$
6. Crosstalk attenuation on far end between circuits of one or several quads not less than	850	nep	-	7.8	$-\frac{1}{2}in\ \frac{l}{850}$
	250	nep	7.8	7.8	
	100	nep	7.8	-	$-\frac{1}{2}in\ \frac{l}{500}$
7. Electrical break-down of insulation:					
a) for all cores with respect to lead sheath	0.05	effective volts	18000	1800	-
b) between circuit cores	"	"	1000	1500	-
c) for signal cores with respect to lead sheath	0.05	"	700	700	-

TABLE 20

ELECTRICAL CHARACTERISTICS OF SHIELDED CIRCUITS FOR MK CABLES
(TWIST PAIRED, DIAMETER OF STRANDS, 1.4 mm)

Characteristic	Frequency, kc	Unit of measure	Numerical value (l_c=850 m)	Conversion coefficient
1. Resistance for core pairs not more than	d.c.	ohm	23.8	$\frac{l}{1000}$
2. Difference of resistances for cores in single pair not more than	"	"	0.14	$\sqrt{\frac{l}{850}}$

(Table continued on page 72)

(Table continued from Page 71)

	Characteristic	Frequency, kc	Unit of measure	Numberical value (l_c=850 m)	Conversion coefficient
3.	Resistance of insulation of cores not less than	d.c.	megohm	10 000	$\frac{1000}{l}$
4.	Rated capacitance: a) nominal value	0.8	nf/km	36.0	$\frac{l}{1000}$
	b) deviation from nominal value	"	"	±3.0	$\frac{l}{1000}$
5.	Capacitive asymmetry of circuit	0.8	nf	1000	$\frac{l}{850}$
6.	Crosstalk attenuation between pairs at near end	0.8	nepers	14	-
7.	Electrical breakdown of insulation a) for cores with respect to lead sheath	0.05	eff. voltage	1800	-
	b) for cores of pairs with respect to each other	0.05	"	1000	-

Parameters for MKB and MKSB cables installed are given in Table 21.

TABLE 21

PARAMETERS FOR HIGH-FREQUENCY CABLE LINES

Freq. kc.	Parameters for MKB cable				Parameters for MKSB cable			
	Milli-nep-km	rad/km	Z ohm	1/degree	Milli-nep-km	rad/km	Z ohm	1/degree
0.8	43.5	0,049	490	-	43.5	0,049	492	-
10	86.0	0,318	195	$3.56.10^{-3}$	87	0,30	196.0	$3.22.10^{-3}$
20	98.0	0,600	182	$2.40.10^{-3}$	100	0,56	183.8	$2.90.10^{-3}$
30	110.0	0,884	178	$2.38.10^{-3}$	114	0,83	179.5	$2.56.10^{-3}$
50	135.0	1,457	174	$1.61.10^{-3}$	136	1,38	175.3	$2.05.10^{-3}$
60	147.5	1,740	175.41	42.10^{-3}	145	1,62	174.6	$1.90.10^{-3}$

(Table continued on Page 73

(Table continued from Page 72)

Freq. kc	β milli-nep-km	α rad/km	Z ohm	αβ 1/degree	β milli-nep-km	α rad/km	Z ohm	αβ 1/degree
110	209.0	3,153	169.0	$1.01.10^{-3}$	200	2,91	169.8	$1.75.10^{-3}$
150	253.0	4,290	167.8	$0.91.10^{-3}$	235	3,93	168.3	$1.75.10^{-3}$
250	336.0	7,160	166.3	$0.78.10^{-3}$	306	6,55	166.8	$1.75.10^{-3}$
550	-	-	-	-	-	17,2	166.7	$1.75.10^{-3}$
800	-	-	-	-	-	26,2	166.5	$1.75.10^{-3}$

Average length for repeater stations for various multiplex systems is given in Table 22.

TABLE 22

AVERAGE LENGTH FOR REPEATER STATIONS FOR VARIOUS MULTIPLEX SYSTEMS

Number of telephone channels in system	Maximum frequency, kc	Average length of sector, km	
		MKB cable	MKSB cable
12	60	46	50
24	108	32	37
60	252	16	19
120	552	-	11
180	800	-	9

5. COAXIAL MAIN-LINE CABLES

Coaxial main-line cables are divided into composite coaxial cables: type KMK (coaxial main-line composite and coaxial type KM (coaxial main-line). Coaxial cable pairs are designed for K-900 multiplex systems, in a frequency range of up to 4.028 kc; K-1920, in a frequency range of up to 8.500 kc; for multiplexing television channels, in the range of up to 8,500 or 12,000 kc.

Two coaxial pairs may be used for transmission using a K-1920 system:

1) for two television channels with an effective range of 6 Mc;
2) or 1920 telephone channels;
3) or 300 telephone channels and two television channels.

Coaxial pairs have the following element measurements:

1) inner copper wire with a diameter of 2.52 mm or 2.57 mm;
2) insulation of polyehtyline washers with a thickness of 2.2 mm arranged 20, 25, or 30 mm from each other;

3) outside wire in the form of a cylinder of copper ribbon with a thickness of 0.3 mm with a lightning joint or crimped joint having an inside diameter of 9.4 mm;

4) magnetic shield consisting of two steel ribbons having a thickness of 0.15 mm;

5) outside insulation consisting of two paper tapes with a thickness of from 0.12 to 0.17 mm.

Cables are made with one, two, and four coaxial pairs.

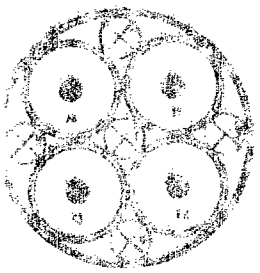
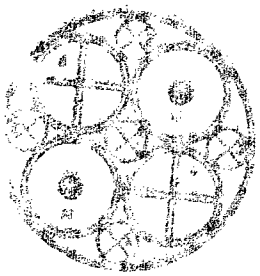
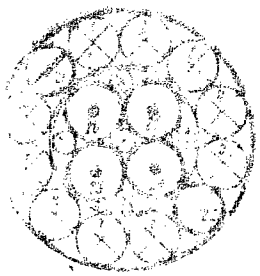
For remote control of long-distance signals and service communications with cables of all types except single-coaxial, there are five quads with star twist having cores with a diameter of 0.9 mm and insulation consisting of two paper tapes, 0.12 mm each.

In composite cables, except for coaxial pairs, the quads are in a star twist with cores of a diameter of 1.2 mm, having twine-paper insulation.

Data concerning the design, dimensions, and weight of coaxial cables are given in Table 23.

TABLE 22

DESIGN, DIMENSIONS, AND WEIGHT OF COAXIAL CABLES

Cross-section of cable	Cable type	Number of twist elements	Diameter through lead, mm	Outside diameter, mm	Weight of 1 km of cable, kg	Factory lengths, m
	KMG-4	4X2T X2.55/9.4+ +4X1K09	33.0	33.0	3355	210±10
	KMB-4		32.5	42.5	4701	210±10
	KMT-4		33.9	50.0	6217	210±10
	KMG-2	2X2 coax. X X2.55/9.4	33.0	33.0	3270	210±10
	KMB-2	+2X4 shielded X X1.2	32.5	42.5	4570	210±10
	KMK-2	+2X4X0.9	33.9	50.0	6131	210±10
	KMKG-4	4X2 coop. X X2.55/9.4	50.4	50.4	6233	210±10
	KMKB-4	+10X X4X1.2+ +2X2 shielded X X1.4+ +4X4X0.9+ +1X2X0.9	49.7	59.7	7348	210±10

The electrical characteristics of cable in factory lengths are given in Table 24.

TABLE 24

ELECTRICAL CHARACTERISTICS OF MAIN-LINE COAXIAL CABLE

	Characteristic	Frequency kc	Unit of measure	Value	Coefficient for conversion to another length
1.	Resistance of inside wire of coaxial pairs not more than	d.c.	ohm	3.8	$\frac{\ell}{1000}$
2.	Resistance of insulation between outside and inside wire not less than	"	megohm	10,000	$\frac{1000}{\ell}$
3.	Value of impedance measured by pulse instrument				
	a) nominal value	"	ohm	75	-
	b) maximum deviation of impedance at input and output of pairs with respect to measured value not more than	"	ohm ohm	+0.65 (for 30%) +0.5 (for 70%)	-
	c) difference of impedance measured at input and output of coaxial pair from all measured values not more than		ohm	0.45 (for 80%) 0.6 (for 20%)	
	d) inner discontinuity, coefficient of reflection at any point for each factory length not more than			2.10^{-3} (for 70%) 3.10^{-3} (for 25%) 4.10^{-4} (for 5%)	-
4.	Crosstalk attenuation between coaxial pairs not less than	300	nep	14	$-\frac{1}{2}\ln\frac{\ell}{210}$
5.	Attenuation equivalent not more than	1000	nep	0.3	$\frac{\ell}{1000}$

(Table continued on Page 77)

(Table continued from Page 76)

Characteristic	Frequency, kc	Unit of measure	Value	Coefficient for conversion to another length
6. Electrical breakdown point of insulation between inside and outside wires (tested for 2 min)	d.c.	v	3700	factory length
7. Electrical breakdown point of insulation between shields of coaxial pairs (tested for 2 min)	0.05	eff. v.	300	factory length
8. Rated voltage of remote power	0.05	eff. v.	1000	repeater station

The electrical characteristics of signal quads are given in Table 25.

TABLE 25

ELECTRICAL CHARACTERISTICS OF SIGNAL QUADS

Characteristic	Freq., kc	Unit of measure	Value	Coefficient for conversion to another length
1. Resistance of pairs of cores not more than	d.c.	ohm	57	$\frac{\ell}{1000}$
2. Resistance of insulation not less than	"	megohm	3000	$\frac{1000}{\ell}$
3. Rated capacitance of circuits	0.8	nf/km	27-38	$\frac{\ell}{1000}$
4. Electrical breakdown of insulation (tested for 2 min)				
a) between circuit cores	0.05	eff. v	700	factory length
b) between cores connecting with lead sheathing	0.05	eff. v	700	"

Factory lengths of cable with average impedance values are divided into five groups as given in Table 26.

TABLE 26

GROUPS OF COAXIAL CABLE

Average value of characteristic impedance	74,35--74,65	74,66--74,90	74,91--75,15	75,16--75,40	75,51--75,65
Cable group	I	II	III	IV	V

A cable group is indicated on the drum by a fraction (for example II/III), the numerator of which indicates terminal group A while the denominator indicates terminal group B. If one of these values for impedance of one lead in a pair should differ from the other values for this same lead by more than 0.25 ohms, an 0 is placed after the group number (for example, I-0/II).

The electrical characteristics for installed repeater sections are given in Table 27.

TABLE 27

THE ELECTRICAL CHARACTERISTICS FOR INSTALLED COAXIAL CABLE
C=47.6 nf/km, γ=2.10^{-3} 1/degree, r_1= 3.8 ohm, r_2=2 ohms

Freq., Mc	β millinep./km	α rad/km	Z ohms	Freq., Mc	β millinep./km	α rad/km	Z ohms
0.06	66	1.397	77.9	5.00	642	111.3	74.43
0.30	157	6.67	75.6	6.00	700	133.5	74.44
1.00	286	22.42	75.0	7.00	784	167.0	74.40
2.00	407	44.67	74.7	8.00	811	178.1	74.39
3.00	498	66.90	74.6	9.00	860	200.3	74.39
4.00	576	189.1	75.4	10.0	910	223.0	74.33
				12.0	996	268.3	74.38

The electrical characteristics for balanced circuits in composite coaxial cables correspond to the data for the appropriate circuits given in Tables 19, 20, and 21.

The standards for electrical characteristics at assembled repeater sections for balanced communications cables using various systems up to 108 kc for multiplexing, and for coaxial cables using multiplexing systems up to 4.5 Mc, are given in the appended departmental technical specifications VTU 175-53, "Electrical-characteristic standards at assembled repeater sections," (Appendix 2).

Electrical characteristic standards for assembled repeater sections with KMB-4 coaxial cables, employing K-1920 (up to 8,500 kc) for multiplexing, are given in the appended "Temporary standards for assembled repeater sections of coaxial cable," as approved by the Main Administration of Interurban Telephone-Telegraph Communications of the Ministry of Communications USSR, dated 25 February, 1958 (Appendix 2-a).

APPENDIX 2

Ministry of Communications USSR

Departmental Technical Specifications (VTU) Interurban Cable Communication Lines Electrical standards for assembled repeater sections

VTU 175-53

Ed. 45

These departmental technical specifications are for sections of interurban cable lines to be used for main-line low-frequency and high-frequency telephone-telegraph communications and for television transmissions.

Note: 1) The length of a section is limited by the distance between the nearest repeater stations, that is, by the length of a repeater section. The length of repeater sections for each communications system is determined by pertinent technical plans. Deviation of the actual length of a repeater section from the planned length must not exceed 5%.

2) Explanation of terms used in these specifications is given in an appendix.

I. TYPES OF INTERURBAN COMMUNICATIONS CABLES

1. Two systems are used for setting up communications over interurban main-line cables:

a) a single-cable system in which both directions of transmission are combined in one cable;

b) a two-cable system in which each direction for transmission is served by a separate cable.

Note. The use of single-cable or two-cable systems is determined by the technical plan.

Promulgated by the	Approved by the	Effective as of
Central Scientific Research Institute of Communications (TsNIIS)	Ministry of Communications USSR 19 September 1953	1 January 1954

2. The following subdivision of cables laid in repeater sections are applicable for multiplex circuits:

a) low-frequency (lf) cables, non-multiplexing, with a range of transmission frequencies of 300 to 3,400 cycles or 300 to 2,400 cycles;

b) low-frequency (lf) cables, multiplex, with 2-channel system equipment (L) in a range of 300 to 5,700 cycles:

c) high-frequency (hf) cables multiplex, with 8-channel system equipment (MEK-8) in a range of 12 to 60 kc;

d) high-frequency (hf) cables, multiplex, with 12-channel system equipment (K-12), in a range of 12 to 60 kc;

e) high-frequency (hf) cables, multiplex, with 24-channel system equipment (K-24) in a range of 12 to 108 kc;

f) coaxial cables, multiplex, with multichannel system equipment (K-900) in a range of 0.3 to 4.5 Mc, or with a V-200 system in a range of 90 to 690 kc.

3. Interurban cables may be subdivided by design as follows:

a) cables with balanced pairs;

b) cables with coaxial (concentric) pairs;

c) cables that are composite, containing balanced and coaxial pairs.

4. Cables that have balanced pairs may be divided according to the insulation of the current-carrying wires into cables with styroflex insulation and cables with twine-paper insulation.

5. Cables laid at repeater sections may be subdivided according to cable circuit inductance into the following types:

a) cables without additional inductance;

b) cables with additional inductance.

Note. Additional inductance is achieved in a cable by connecting coil inductance as shown in Table 1.

TABLE 1

Type of cable and system of multiplex	Circuit	Coil inductance, in millihenries	Nominal spacing for connecting coils, m
Lf cable, non-multiplex	Basic	100 or 140	1700
	Artificial	70 or 56	1700
	For broadcast	12	1700
Lf cable, multiplex, with 2-channel equipment	Basic	30	1700
	Artificial	12	1700
Hf cable multiplex, with 8 or 12-channel equipment	Basic with styroflex insulation	1.75	284
Same	Basic with twine-paper insulation	1.0	425

II. D-C ELECTRICAL STANDARDS

6. Electrical indices for assembled sections of balanced communications cables carrying direct current must conform to the standards set forth in Table 2.

TABLE 2

Standards for repeater sections on d.c. with balanced communications cables,[1] having

Indices	Styroflex insulation		Twine-paper insulation	
	Copper wire	Aluminum wire	Copper wire	Aluminum wire
1. Resistance of insulation between each wire and all remaining wires connected to ground, at t=20° C in megohms per km, not less than	20,000[2]	20,000[2]	10,000	10,000
2. Rated capacitance [3]:				
a) between wires of basic circuit in nf/km, not more than	24	24	27	27
b) between pairs of artificial circuit in nf/km, not more than	64	64	69	69
c) between wires of a shielded pair in nf/km, not more than	-	-	36	36
3. Test voltage for electrical breakdown of insulation[4]:				
a) between bundle of all wires and lead sheath, in v, not less than	1500	1500	1500	1500
b) between wires a connected to the bundle and wires b also connected to the bundle, in v, not less than	1000	1000	1000	1000
4. Resistance of wires[5] at t=20° C (diameter of wire, d in mm):				
a) of the basic circuit (loop of wires) in ohms/km, not more than	$\frac{46}{d^2}$	$\frac{75}{d^2}$	$\frac{46}{d^2}$	$\frac{75}{d^2}$
b) artificial circuit in ohms/km, not more than	$\frac{23}{d^2}$	$\frac{37.5}{d^2}$	$\frac{23}{d^2}$	$\frac{37.5}{d^2}$

(Table continued on Page 83)

(Table continued from Page 82)

Indices	Copper wire	Aluminum wire	Copper wire	Aluminum wire
5. Difference in resistances (ohmic imbalance) for a length of repeater section, l in km: a) between wires (with diameter d in mm) of basic circuit in ohms for entire repeater section, not more than	$\frac{0.23}{d^2}\sqrt{l}$	$\frac{0.37}{d^2}\sqrt{l}$	$\frac{0.23}{d^2}\sqrt{l}$	$\frac{0.37}{d^2}\sqrt{l}$
b) between pairs in artificial circuit, in ohms, for entire repeater section of circuit, not more than	$\frac{0.23}{d^2}\sqrt{l}$	$\frac{0.37}{d^2}\sqrt{l}$	$\frac{0.23}{d^2}\sqrt{l}$	$\frac{0.37}{d^2}\sqrt{l}$

Notes: 1) Standards given in Table 2 apply also to balanced pairs of composite cables.

2) In some cases, the resistance of cable insulation made of styroflex may be lower than the values given in Table 2, but it will not be lower than 10,000 megohms per km.

3) Rated capacity is given for cables made in accordance with VTU 0736-51 and TUK 98-50. Rated capacity of cable circuits for other types of cables must conform to the technical specifications in effect for these cables.

4) Only those sections where remote power is to be used are tested for the breakdown point of the insulation.

5) The resistance of cable circuits with additional inductance is determined as the sum of two resistances: the resistance of cable wires from Table 2 and the resistance of inductance coils, the latter being taken from pertinent technical specifications. The resistance of circuits having cables with bimetallic wires must conform to the technical specifications for these cables.

7. The electrical indices for assembled sections of coaxial communications cables for direct current must conform to the standards given in Table 3.

TABLE 3

Indices	Standards for repeater section having coaxial communication cables[1] and operating on d.c.; insulation in form of discs or spiral	
	copper wires	aluminum wires
1. Resistance of insulation at temperature of 20° C;		
a) between inside and outside wires, in megohms, not less than	10,000	10,000
b) between outside wires and all other wires connected to ground, in megohms per km, not less than	10	10
2. Test voltage breakdown point of insulation		
a) between inside and outside wires, in kv, not less than	2.0	2.0
b) between outside wires laid along side coaxial pairs, in kv, not less than	0.3	0.3
3. Resistance of wires[2] with temperature of 20° C;		
a) of inside wire (with diameter d in mm) in ohms per km, not more than	$\frac{22.5}{d^2}$	$\frac{37}{d^2}$
b) of outside wire (with diameter D in mm and with a thickness of current-carrying wall, t, in mm) in ohms per km, not more than	$\frac{5.5}{Dt}$	$\frac{9}{Dt}$

Note: 1) The standards given in Table 3 hold also for coaxial pairs of composite cables.

2) The resistance of bimetallic conductors both inside and outside must conform to the technical specifications for such cables.

8. The potential of the lead sheath on a cable with respect to ground at any point of a repeater section must be negative.

9. The resistance of the insulation between a connecting box casing on a derrick and the ground must be at least one megohm.

III. A-C ELECTRICAL STANDARDS

10. Electrical indices for assembled sections of balanced lf communications cables on a.c. must conform to the standards given in Table 4.

TABLE 4

Indices	Standards for a.c. for repeater section of balanced 1f communications cables for circuits with additional inductance[1] and equipped with amplifiers			
	universal (amp)			
	2-conductor 800 cycles	4-conductor 800 cycles	broadcast, 5kc	L system, 5 kc
1. Nominal value of characteristic impedance in both directions from repeater section				
a) of a basic circuit, in ohms	1460[2] / 1520	1460[2] / 1570	517	960
b) of an artificial circuit, in ohms	765[2] / 760	765[2] / 780	110	445
2. Deviation of characteristic impedance from nominal value, in percent, within limits of	±5	±9	±9	±9
3. Attenuation equivalent at temperature of 20° C:				
a) of a basic circuit, in nepers, not more than	1.6[2] / 1.6	2.4[2] / 2.8	4.0[3]	3.5
b) of an artificial circuit, in nepers, not more than	1.6[2] / 1.6	2.3[2] / 2.6	4.0[3] or [4]	3.5
4. Shielding for the circuit from crosstalk on its receiving end, in nepers, not less than	7	7.5	9.5	7.5
5. Asymmetry of the circuit relative to ground, in nepers, not less than	7	7.5	9.5	7.5

Notes: 1) The electrical standards cited in Table 4 refer to cable circuits with additional inductance. These circuits in the repeater stations must terminate at half spacing and throughout the distance of a repeater section must have coil input spacing which does not deviate from standard spacing by more than ±0.5%.

2) The values in the numerator refer to circuits with inductive coils, 100/70 millihenries, and in the denominator, to circuits with inductive coils, 140/56 millihenries.

3) If the value for equivalent attenuation throughout an entire section for broadcast circuits is planned (as an exception) to be somewhat larger than the standard indiated in 3a and 3b, the measured attenuation must not exceed the planned.

4) The value indicated for equivalent attenuation refers to artificial circuits without additional inductance.

11. The electrical indices for assembled sections of balanced lf communications cables for a.c. must conform to the standards shown in Table 5.

TABLE 5

Indices	Standards, with a.c., for repeater section of balanced hf cables[1] for circuits with additional inductance and multiplexed with the following systems: MEK-8 at 60 kc	K-12 at 60 kc	without additional inductance K-12 at 60 kc	K-24 at 108 kc
1. Nominal value of characteristic impedance measured at both ends of a repeater section, in ohms	700[2] / 450	700[2] / 450	170[3] / 180	170[3] / 180
2. Deviation of characteristic resistance from nominal value in percent must not be more than	±10	±10	±7	±7
3. Equivalent attenuation of a circuit at temperature of 20° C, in nepers:				
a) average value, not more than	4.5[4]	6.7[4]	6.7[4]	7.0[4]
b) maximum value, nor more than	-	8.5[5]	8.5[5]	8.0[5]
4. Shielding of circuit from crosstalk:				
a) on receiving end, in nepers, not less than	7.0[6] / 7.5	7.0[6] / 7.5	8.0[6] / 8.5	8.0[6] / 8.5
b) on transmitting end, in nepers, not less than	6.5	6.5	7.5	7.5

Notes: 1) The standards given in Table 5 refer also to balanced pairs of composite cables.

2) The value given in the numerator refers to circuits with inductive coils, 1.75 millihenries when coil input spacing is 284 m; and the value in the denominator is for circuits with inductive coils, 1 millihenry when coil input spacing is 425 m.

3) The value in the numerator refers to circuits with twine-paper insulation, and the value in the denominator refers to circuits with styroflex insulation.

4) If the length of a repeater section l is less than the average arithmetical value of all lengths of sections for a given cable main line, equivalent attenuation of a circuit at that repeater section must not exceed the value βl, where β is the kilometric attenuation of the cable being measured.

5. If the plan, as an exception, provides for a value of equivalent attenuation somewhat larger than that indicated in 3b, the measured value for equivalent attenuation must not exceed the planned.

6. The value in the numeratore refers to 100% of the circuits, and the value in the denominator refers to 80% of the circuits.

12. The electrical indices for assembled sections of coaxial cables on a.c. must conform to the standards shown in Table 6.

TABLE 6

Indices	Standards, with a.c., for repeater section of coaxial cables[1] for circuits equipped with systems:			
	V-200 at 600 kc	K-900 at 4 Mc	television[2] at 4 Mc	television[2] at 7 Mc
1. Nominal value for characteristic impedance at both ends of repeater section, in ohms	70	75	70	75
2. Circuit discontinuity for characteristic impedance, in percent, must not exceed	±2.0	±1.2	±1.7	±1.2
3. Equivalent attenuation of circuit at temperature of 20° C:				
a) average value, in nepers, not more than	-	4.4	5.6	5.8
b) maximum value, in nepers, not more than	5.6	5.0	7.2	6.6
4. Shielding of circuit from crosstalk[3]:				
a) at receiving line, in nepers, not less than	9.5	9.5	9.5	9.5
b) on transmitting line, in nepers, not less than	9.5	9.5	9.5	9.5

Notes: 1) The electrical standards given in Table 6 for assembled sections of coaxial cables refer also to coaxial pairs of composite cables. The standards for coaxial pairs should be regarded as recommended only.

2) The standards in the fourth vertical column refer to a cable with a diameter for the inside wire of 5 mm and with an inside diameter of the pipe of 18 mm. Those in the fifth column refer to cables with diameters of 2.55 and 9.4 mm respectively.

3) The values shown in 4a and 4b refer to a frequency of 90, kc.

13. For all the above-indicated electrical indices of cable circuits (basic, artificial, non-multiplexed, and also multiplexed with systems L, MEK-8, K-12, K-24 K-900), the frequency characteristic for the whole range of transmitted frequencies must be taken down.

The basic frequencies for measuring electrical indices on a.c. must conform to the data given in Table 7.

TABLE 7

Measured frequencies

In cycles			In kilocycles		In megacycles			
For basic and artificial nonmultiplexed circuits	For basic and artificial circuits multiplexed with system L	For broadcast circuits	For circuits multiplexed with systems K-12 and MEK-8	For circuits multiplexed with system K-24	For circuits multiplexed with system K-900		For television circuits	
300	300	100	10	10	0.09	1.50	0.3	2.00
400	600	600	15	20	0.2	1.75	0.4	2.5
600	1000	1000	20	30	0.3	2.00	0.5	3.0
800	1500	1500	25	40	0.4	2.25	0.6	3.5
1000	2000	2000	30	50	0.5	2.50	0.7	4.0
1200	2500	3000	35	60	0.6	2.75	0.8	4.5
1600	3000	4000	40	70	0.7	3.00	0.9	5.0
2000	3500	5000	45	80	0.8	3.25	1.0	5.5
2500	4000	6000	50	90	0.9	3.50	1.25	6.0
3000[1)]	4500	7000	55	100	1.0	3.75	1.50	6.5
3400	5000	8000	60	110	1.25	4.00	1.75	7.0

Notes. 1) For basic circuits with inductive coils, 140 millihenries, and artificial circuits with coils, 70 millihenries, tests at frequencies of 3,000 cycles or higher are not required.

2) Frequency characteristics for electrical indices throughout the whole range of transmitted frequencies must fall within the limits shown in Tables 4, 5, and 6.

3) If the frequency characteristic of any electrical index measured at the frequencies given in Table 7 deviates in any frequency range from the theoretical value, or if their inherent regularity is disrupted with a tendency to disrupt permissible limits, the tests must be repeated. In case the second measurement gives the same results, it will be necessary to take measurements in the same frequency range where the deviation is observed at additional frequencies using intervals that are only a fifth to a tenth as large as those shown in Table 7.

IV. REGULATIONS REGARDING TESTING

14. Tests of assembled cables at a repeater section must be made from cable junction boxes after construction and installation work has been completed at that section.

15. All conductors in a cable are tested for conformance to the requirements set forth in 6 and 7 of the technical specifications. Each cable laid at a repeater section is tested for conformance to the requirements of 8. Each junction box set up at an input bay is tested for conformance to 9. All cable circuits are tested for conformance to the requirements of 10, 11, and 12 at the frequencies indicated in Tables 4, 5, and 6. All types of circuits in each cable are tested for conformance to the requirements of 13; 10% of all circuits are to be tested and not less than one circuit of each type.

Notes: 1. Tests in accordance with 13 to the extent of 10% do not apply to measurements made during the production and installation of a cable.

2. Tests for crosstalk shielding on transmitting and receiving leads performed in accordance with 13 on balanced cable, must apply as well to the combinations of circuits inside one quad.

3. The following may be excepted from the tests indicated in 15:

a) electrical measurements for rated capacitance of circuits of all types;

b) electrical measurements for characteristic impedance of high-frequency circuits without additional inductance, on the condition that cable of a single type and from a single manufacturer is laid at the completely assembled repeater section. Records of electrical measurements of parameter readings should not be released when main-line cable facilities are put into operation. Instead of these, the factory specification sheet for factory cable lengths laid at a repeater section should be affixed to the technical documents which go with the assembled repeater section.

4. Capacitive balancing at sleeves of short junction lines composed of coil-loaded cables without duplex amplifiers is to be excluded from the installation process.

16. All tests must be made for repeater sections in accordance with the technical plan separately for each system of communications. For example, on main lines with cable of 32 x 2 for lf communications, the length of a repeater section is 100 to 120 km; while for hf communications it is 30 to 40 km. Consequently, hf circuit measurements must be made in 30-to 40-km sections, and lf circuit measurements in 100-to 120-km sections.

17. The results of measuring insulation resistance between conductors, insulation resistance between a conductor and ground, the resistance of conductors and of the equivalent attenuation of circuits carrying high-frequency transmission derived at a temperature other than 20° C, must be converted to readings for a temperature of 20° C.

18. Each circuit is to be tested for crosstalk shielding with respect to all circuits on which it is anticipated that the frequency transmission range will coincide with the range of the circuit being checked. A test of shielding on the receiving end must be made relative to transmission circuits of the same and of the opppsite direction. And a test of shielding on the transmitting end is to be made only with respect to circuits of the same direction.

Note. With two-cable main line, the number of tests for crosstalk shielding at the receiving end relative to circuits of the opposite direction of transmission may be reduced to 5% of the number of combinations subject to measuring.

19. If, in the tests as described in 6-13, it turns out that even one index does not meet the standard, the cable section is to be turned back and to be accepted again only after the defect has been removed.

20. The specification sheets for electrical measurements must be filled out in complete accord with the instruction of the Ministry of Communications, as amended, for licensing cable communications facilities.

V. TESTING METHODS

21. Resistance of the insulation between a conductor and all other conductors connected to ground or between separate conductors, as well as the resistance of the insulation of a junction box, is measured by the comparison method. The voltage of the battery being measured must fall within the range of 100 to 500 v, and readings on the galvanometer must be made after current has been flowing for a minute. The soil temperature on the day measurements are made of a cable should be determined by inquiring at the nearest weather station or by referring to the average seasonal curve for temperature changes.

Converting measured insulation resistance to that for 20° C is done by using the following formula:

$$R_{20} = \frac{R_t}{1 + a_R (t-20)}$$

in which R_t is the measured resistance at a temperature of t degrees,

a_R is the temperature coefficient of the resistance, the same for paper (-0.060) and for styroflex (-0.001).

22. Rated capacitance between conductors or between pairs of conductors is measured by the comparison method. Battery voltage and time of charge of the conductors are the same as when measuring the resistance of insulation.

23. The resistance of conductors and the ohmic asymmetry of conductors are measured by the ground loop method. Converting the measured resistance of conductors to the equivalent for 20° C is done by using formula (1), (par. 21). The temperature coefficient of the resistance is taken for copper as +0.0040, and for aluminum as +0.0042.

24. Insulation puncture strength is checked by means of a d-c device or by means of standard-frequency a.c. When using a.c. to test breakdown voltage and when measuring the effective voltage value with a voltmeter, the permissible voltage should be lowered by 1.4 times. In both cases, tests should last for 40 minutes.

25. The characteristic resistance of circuits is measured by an a-c differential bridge. The deviation of the characteristic resistance from the nominal value, in percent, may be computed from the formula

$$\delta = \frac{[Z_{si} - Z_{sn}]\ 100}{[Z_{sn}]}\ \% \qquad (2)$$

where Z_{si} is the measured value of characteristic resistance,

Z_{sn} is the nominal value of characteristic resistance.

Circuit discontinuity for coaxial pairs is measured by a pulse device. The value for discontinuity, in percent, is determined by the calibration curve of the pulse device.

26. The equivalent attenuation of a circuit is measured by the comparison method using an attenuation box or an attenuation meter. The circuit being measured and the attenuation box must be loaded for the characteristic resistance. Converting the equivalent attenuation of a circuit to that for 20° C is done with the following formula:

$$b_{20} = \frac{b_t}{1 + a_\beta (t-20} \qquad (3)$$

where b_t is the measured attenuation at temperature t°,

a_β is the temperature coefficient of attenuation.

The temperature coefficient of attenuation has the following values:

a) for cable with paper insulation and with a frequency of 60 kc, 0.0012; when the frequency is 108 kc, 0.0007;

b) for cable with paper insulation and with additional inductance at a frequency of 800 cycles 0.004; at a frequency of 5,000 cycles, 0.004; at a frequency of 60,000 cycles, 0.000;

c) for cable with styroflex insulation at a frequency of 60 kc, 0.0025; and at a frequency of 108 kc, 0.0020;

d) for cable with styroflex insulation and with additional inductance at a frequency of 60 kc, 0.0025;

e) for coaxial cable at a frequency of from 0.3 to 7 Mc, 0.0020.

27. The shielding of a circuit from crosstalk on the receiving lead is measured by the comparison method and is computed by using the following formula:

a) when the measurement is for circuits with transmission in a single direction: (see Rukovodstvo po elektricheskim izmereniyam liniy svyazi [Manual for Electrical Measurements of Communications Lines,] Figure 21 or 23, Svyaz'izdat, 1947.)

$$b_0 = B_{meas} + b_1 - (P_1-P_2) - \tfrac{1}{2} \ln \left[\frac{Z_{s1}}{Z_{s2}} \right] s \quad (4)$$

b) when the measurement is for circuits in which the transmission is in opposite directions (see above-cited reference):

$$b_0 = B_{meas} - (P_1-P_2) - \tfrac{1}{2} \ln \left[\frac{Z_{s1}}{Z_{s2}} \right] \quad (5)$$

in formulas (4 and 5)

B_{meas} is the value read directly on the crosstalk attenuation meter box;

b_1 is the equivalent attenuation of the influencing circuit;

P_1 is the level set by the plan on the transmitting end of the influence circuit;

P_2 is the level set by the plan on the transmitting or on the receiving end of a circuit subjected to an influence;

Z_{s1} is the characteristic resistance of the influencing circuit;

Z_{s2} is the characteristic resistance of the circuit subjected to an influence.

Circuit crosstalk shielding on the transmitting end relative to circuits with a single transmitting direction is measured as shown in the diagram in Figures 20 or 22 of Rukovodstvo po elektricheskim izmereniyam liniy svyazi and is computed by using formula 5.

28. Asymmetry in a circuit relative to ground is measured by the comparison method and is computed by the formula $b_a = B_{meas}$. A single-conductor artificial circuit made up of wires in the circuit being checked and of the lead sheath is used for the influencing circuit.

29. The potential of the lead sheath with relation to ground is measured by a d-c multimeter (ampere-volt-meter) with an input resistance of not less than 10,000 ohms for one volt on the scale. Non-polarizing electrodes should be used for grounds. The grounding electrode should be located at a distance of not less than one meter from the cable being tested.

TERMINOLOGY USED IN VTU 175-53

1. Line characteristic resistance.

Line characteristic resistance is the total resistance equal to the geometric average of the resistances of a short circuit and open circuit, that is,

$$Z_s = \sqrt{Z_{sc} Z_{oc}}$$

2. Equivalent attenuation of a line (b).

Equivalent attenuation of a line is the actual component of direct transmission, as determined by the equation

$$g = \frac{1}{2} \ln \frac{P_n}{P_k}$$

in which P_n is the apparent power of a signal at an observed point, P_k is the apparent power of interference or crosstalk at the same point of a line when the leads of the latter are shorted to resistances equal to the characteristic-resistances of the line.

3. Shielding of the circuit (b_o).

Circuit shielding at the observed point is the actual component of the equation $\frac{1}{2} \ln \frac{P_s}{P_{sh}}$, where P_s is the observed power of a signal at an observed point, and P_{sh} is the apparent power of interference or crosstalk at the same point on the line when the leads of the latter are shorted to resistances equal to characteristic line resistances.

One should distinguish between the shielding at the transmitting end when the observed point of a circuit is at the transmitter and the shielding at the receiving end when the observed point of a circuit is at the receiver.

4. Equivalent attenuation (B).

Equivalent attenuation between two circuits is the actual component of the equation $\frac{1}{2} \ln \frac{P_1}{P_2}$, in which P_1 is the apparent power in the influencing circuit, and P_2 is the apparent power in the circuit subjected to influence. Measurement of these powers is made at definite points along a line, with the leads of both circuits shorted to resistances equal to characteristic line resistances.

Crosstalk attenuation at the near end (B_o) and crosstalk attenuation at the far end (B_f) should be distinguished.

Crosstalk attenuation at the near end is determined by values P_1 and P_2 measured on one end of the line.

Crosstalk attenuation at the far end is determined by the values: P_1 measured at one end of the line, and P_2 measured at the other end of the line.

5. Resistance between crosstalk attenuation and shielding.

Crosstalk attenuation and shielding of a circuit are related to each other by the equation

$$B = b_o \div (p_1 - p_2)$$

in which b_o is the circuit shield,

p_1 is the level determined by the plan for the transmitting end of the influencing circuit,

p_2 is the level determined by the plan for the transmitting or receiving end of the circuit subjected to influence.

APPENDIX 2a

Approved by the Main Administration for Interurban Telephone and Telegraph Communications, 25 February 1958.

TEMPORARY ELECTRICAL STANDARDS FOR ASSEMBLED REPEATER SECTIONS OF COAXIAL CABLE, KMB-4

These electrical standards are disseminated for the assembled repeater sections of circuits having KMB-4 and KMKB-2 coaxial cable:

a) using coaxial pairs for K-1920 multiplexing equipment (1920 telephone channels and black-and-white television) in a frequency range of from 300 kc to 9 Mc;

b) using coil-loaded and non-coil-loaded service-communication lf pairs;

c) using separate conductors for telesignaling and for remote servicing.

I. CLASSIFICATION OF REPEATER SECTIONS

1. The electrical characteristics cited below for circuits refer to repeater sections whose length is taken

a) for coaxial pairs 2.52/9.5--repeater section K-1920 (6 ± 0.3 km);

b) for circuits of signal quads:

1) to be used for service communications on lf with amplifiers (non-coil-loaded circuits) throughout the entire section between lf amplifiers,

2) to be used for service communications between OUP's without amplifiers (coil-loaded circuits) throughout the entire section between OUP's;

c) for separate conductors of telesignaling and for remote servicing--for a section between junction boxes of adjacent NUP's; and for conductors to which low-pressure warning devices are connected--for an OUP-ROUP section.

II. ELECTRICAL STANDARDS FOR DIRECT CURRENT WHEN t = 20° C

Standards for electrical characteristics of coaxial pairs (with terminal hermetically sealed sleeves) are given in Table 1.

TABLE 1

STANDARDS FOR ELECTRICAL CHARACTERISTICS OF COAXIAL PAIRS

No.	Indices	Unit of measure	Standard	Length, m	Coefficient For conversion to another length
1	Resistance of conductors not more than:	ohm			$\frac{\quad}{1000}$
	a) of the central conductor		3.8	1000	
	b) of the outside conductor		2.0	1000	
2	Resistance of the insulation between central and outside conductors, not less than	megohm	10,000	1,000	$\frac{1000}{\quad}$
3	Electrical breakdown point of insulation between central and outside conductors in the absence of full pressure in the cable, not less than	v	3000[1)]	repeater section	-
4	Electrical breakdown point of the insulation between outside conductors of any coaxial pair	v	450	repeater section	-

Note. 1) When there is full pressure of 0.5 to 0.6 atm, this value should be not less than 4,000-4,500 v.

Standards for the electrical characterics of signal quad circuits are given in Table 2.

TABLE 2

STANDARDS FOR ELECTRICAL CHARACTERISTICS OF SIGNAL QUADS

No.	Indices	Unit of measure	Standard	Length, m	Coefficient for conversion to another length
1	Resistance of conductors, no more than	ohm			
	a) for separate conductors[1]		28.5	1000	$\frac{\ell}{1000}$
	b) for circuits[1]		57	1000	$\frac{\ell}{1000}$
2	Resistance of insulation between each conductor and all other conductors connected to ground and lead sheathing, no less than	megohm	3000	1000	$\frac{1000}{\ell}$
3	Difference in resistance (ohmic asymmetry) throughout the length of a repeater section between conductors of basic circuit	ohm	0,285	1000	$\frac{\ell}{1000}$
4	Electrical breakdown point of the insulation between a bundle of all conductors and lead sheath, and also between bundle of cores a and bundle of cores b, not less than	v	1,000	repeater section	-

Note: 1) For coil-loaded circuits, the resistance of conductors is determined as the difference of the measured value and the resistance of 10-ohm loading coils connected to a coil.

ELECTRICAL STANDARDS WITH ALTERNATING CURRENT WHEN t = 20° C.

Standards for the electrical characteristics of coaxial pairs are given in Table 3.

TABLE 3

STANDARDS FOR ELECTRICAL CHARACTERISTICS OF COAXIAL PAIRS

No.	Indices	Unit of measure	Standard	Temporarily permissible value	Length, m	Coefficient of conversion
1	Equivalent attenuation	nep.	$0.285\sqrt{f} + 0.00075f$	-	1000	$\frac{\ell}{1000}$
2	Crosstalk attenuation between any coaxial pairs at near end, not less than	nep.	$9.2+8.4\sqrt{f}$	-	repeater section	-
3	Shielding when affected by influence between any coaxial pairs on far end, not less than	nep.	$8.1+8.4\sqrt{f}$	-	"	-
4	Average value for impedance when f = 1 Mc	ohm	75±1		"	-
5	Maximum deviation of input resistance modulus from average curve, not more than	ohm	-	±2.25	"	-
6	Maximum value of discontinuity, measured by pulse meter, not more than	ohm	±0.6	±0.8	"	-
7	When measuring a section of from 1.7 to 2 km and when τ = 0.12 microsec, not more than	ohm	±0.6	±0.8	section 1.7-2 km	-

(Table continued on Page 99)

(Table continued from Page 98)

No.	Indices	Unit of measure	Standard	Temporarily permissible value	Length, m	Coefficient of conversion
8	Average mean square of three maximum discontinuities when τ = 0.4 microsec, not more than	ohm	0.42	0.6	repeater section	-
9	When measuring a section where l = 1.7 to 2 km, and τ = 0.12 microsec, not more than	ohm	0.42	0.6	repeater 1.7-2 km	-

Standards for the electrical characteristics of the balanced circuits of service communications are given in Table 4.

TABLE 4

STANDARDS FOR ELECTRICAL CHARACTERISTICS OF SERVICE COMMUNICATIONS CIRCUITS

No.	Indices	Unit of measure	Standard
1	Nominal value for characteristic resistance at both ends of repeater section of coil-loaded circuit when frequency is 800 cycles	ohm	1460
2	Deviation of characteristic resistance of coil-loaded circuit from nominal value, within limits no greater than	0/0	±15

(Table continued on Page 100)

(Table continued from Page 99)

No.	Indices	Unit of measure	Standard
3	Shielding of circuit from cross-talk at receiving end with frequency of 800 cycles for coil-loaded and non-coil-loaded circuit, not less than	nep	7
4	Equivalent attenuation of circuit at frequency of 800 cycles, not greater than		
	a) for coil-loaded circuit	nep/km	0.025
	b) for non-coil-loaded circuit	nep/km	0.065
5	Asymmetry of circuit relative to ground with frequency of 800 cycles for coil-loaded and non-coil-loaded circuit, not less than	nep	7

III. REGULATIONS GOVERNING INSPECTION

6. Testing of assembled cables at a repeater section must be carried out from the hermetically-sealed sleeves on coaxial pairs and from the cable junction boxes of balanced quads after the completion of construction and installation operations on that section.

7. All cables at each repeater section must be tested for conformance to the electrical characteristics set forth in Tables 1-4.

8. All tests must be made on repeater sections in conformance to a technical plan individually for each communications system. For example, for coaxial pairs, tests are to be made on a section of system K-1920 (6±0.3 km); for service communications circuits, over non-coil-loaded circuits, on a section between lf amplifiers; for a service communications circuit on coil-loaded pair, on a section between OUP's; for signal cores, on a section on which a signal core is active or on a section between junction boxes of adjacent NUP's.

9. All results of measuring insulation resistance between conductors, the insulation resistance between conductors and ground, the resistance of conductors and equivalent attenuation of circuits carrying high frequency, which are derived at some temperature other than + 20° C, must be converted to +20° C.

10. Each circuit is tested for shielding from crosstalk with respect to all circuits along which it is planned to transmit a range of frequencies coinciding with the range of frequencies in the circuit being checked. A test for shielding on the receiving lead must be made relative to all lf service communications circuits.

11. If the testing brings out even one index which does not satisfy the standard, the cable section is to be rejected and approved only after the defect is removed.

12. Electrical measurement records are to be made out in complete conformance with the instructions, as amended, of the Ministry of Communications for certifying communications cable facilities.

IV. TEST METHODS

13. Insulation resistance between each conductor and all other conductors connected to ground, or between separate conductors, is to be measured by the comparison method. Measuring battery voltage should be within 100 to 500 v, and readings on the galvanometer should be made after current has been allowed to flow for one minute. Soil temperature on the day of measuring the cable should be determined by inquiring at the nearest weather station, or at least by checking the average curve for seasonal temperature changes. Conversion of the measured resistance of insulation to the equivalent for 20° C can be done with the formula

$$R_{20} = \frac{R_t}{1 + a_R (t-20)}$$

in which R_t is the measured resistance of insulation at temperature t°,

a_R is the temperature coefficient of insulation resistance, equal, for paper, to -0.060.

14. The resistance of conductors and the ohmic asymmetry of conductors are measured by the ground loop method. Conversion of the measured resistance of conductors to that for 20° C is done by using the formula given in par 13. The temperature coefficient of the resistance of copper cores is +0.0040.

15. The breakdown of insulation is checked by means of d-c equipment. Tests are made for 2 minutes.

16. The input resistance of a circuit is measured with an a-c differential bridge or with a visual meter for measuring the modulus of input resistance. Deviation of characteristic resistance from the nominal value, in percent, is computed from the formula

$$\delta = \left[\frac{Z_{sk} - Z_{sn}}{Z_{sn}}\right] \cdot 100\%$$

where Z_{sk} is the measured value of input resistance;

Z_{sn} is the nominal value for impedance at a given frequency.

17. The discontinuity of coaxial pairs is measured by a pulse meter with a pulse length of $\tau = 0.4$ microsec. (at 0.1 of the height from the base pulse). The discontinuity value in ohms is determined by a calibration curve of the pulse meter in accordance with the instructions attached to it.

18. The equivalent attenuation of a circuit is measured by the comparison method using an attenuation box or an attenuation meter. The circuit being measured and the attenuation box must be loaded to the characteristic resistance. The conversion of the equivalent attenuation of a circuit to that for a temperature of 20° C is done by using the formula

$$b_{20} = \frac{b_t}{1 + \alpha\beta(t-20)}$$

where b_t is the measured attenuation at temperature t°;

β is the temperature coefficient of attenuation which, for circuits with paper insulation at a frequency of 800 cycles and at all frequencies in the lf range, is 0.004; and for coaxial pairs in the frequency range above 300 kc is 0.002.

19. Shielding of a balanced circuit from crosstalk on the receiving lead is measured by the comparison method and is computed by means of the following formula:

a) when the measurement is of circuits with transmissions going in one direction only

$$b_o = B_{meas} + b_1 - (p_1 - p_2) - \tfrac{1}{2} \ln \frac{Z_{s1}}{Z_{s2}}$$

b) when the measurement is of circuits with transmissions going in opposite directions

$$b_o = B_{meas} - (p_1 - p_2) - \tfrac{1}{2} \ln \frac{Z_{s1}}{Z_{s2}}$$

In these formulas, B_{meas} is the value read directly on the crosstalk attenuation meter box;

b_1 is the equivalent attenuation of the influencing circuit;

p_1 is the level set by the plan at the transmitting or receiving end of a circuit subject to influence;

p_2 is the level set by the plan at the transmitting end of the influencing circuit;

Z_{s1} and Z_{s2} are the characteristic resistance of circuits corresponding to the influencing circuit and the circuit subjected to influence respectively.

20. Crosstalk attenuation at the near end and shielding at the far end when there is interaction between coaxial pairs is measured by means of the comparison method using a non-symmetrical attenuation box for the frequency range under measurement.

21. Asymmetry of a circuit for alternating current relative to ground is measured by the comparison method and is computed $b_a = B_{meas}$. A single-conductor circuit made up of conductors of the circuit being checked and of the lead sheath is used as the influencing circuit.

V. EXTENT OF MEASUREMENTS

22. Electrical measurements of conductors and circuits for cables for assembled repeater sections must be made, as a minimum, as follows:

A. Direct current.

1. Insulation resistance measurement:

a) coaxial pairs--100% (all pairs);

b) conductors and circuits in balanced quads--100%

2. Conductor resistance measurements:

a) coaxial pairs--100%;

b) symmetrical quads--100%.

3. Measurement of the difference in resistances (of the ohmic asymmetry of circuits in service communications for symmetrical quads--100%).

4. Tests for electrical insulation breakdown point:

a) coaxial pairs--100%,

b) between return conductors of coaxial pairs--100%,

c) for conductors of symmetrical quads--100%, except for coil-loaded circuits and conductors used for low-pressure warning signal equipment.

B. Alternating current.

1. Measurement of the discontinuity of coaxial pairs with a pulse meter at both ends of a repeater section--100%.

2. Measurement of input resistance:

a) of coaxial pairs--each coaxial pair at both ends of a repeater section in a range of from 300 kc to 9 Mc using a visual meter for measuring the modulus ofinput resistance.

Note. Until visual meters are manufactured, input resistance may be measured with a differential bridge. Measurements may be made at each end of a repeater section only for one coaxial pair having a maximum discontinuity on the first half of the pulse characteristic.

b) of symmetrical coil-loaded circuits--from both ends of a section between OUP's at frequencies of 300, 400, 600, 800, 1000, 1200, 1600, 2000, 2500, and 3000 cycles.

3. Measurement of equivalent attenuation:

a) of one coaxial pair having the maximum value for discontinuity, at each repeater section throughout a frequency range of 300 to 500 kc, every 50 kc; in the range of 500 to 1,000 kc, every 100 kc; in the range of 1,000 to 9,000 kc, every 200 kc.

b) of a symmetrical coil-loaded circuit and one non-coil-loaded circuit at a frequency of 800 cycles.

4. Measurement of the shielding of circuits from crosstalk:

a) from crosstalk between coaxial pairs on transmitting and receiving leads, at frequencies of 100, 200, 300, 400, and 500 kc at each repeater section for any two combinations: between diagonal and adjacent pairs in both directions along a repeater section for 20% of the repeater sections.

b) shielding of symmetrical circuits at a frequency of 800 cycles for all combinations of service communications pairs.

APPENDIX 2B

STANDARDS FOR THE ELECTRICAL CHARACTERISTICS OF HF CABLE CIRCUITS OF BALANCED DESIGN FOR REPEATER SECTION SYSTEMS K-60 and K-24, AT T= +20° C

Characteristic	Unit of measure	Frequency of current measured	Standard
Resistance of insulation between each core and remaining cores connected to grounded sheath, not less than	megohms/km	d-c	10,000
Resistance of core pairs, not more than	ohm/km	d-c	
diameter of core--0.9 mm			57.0
diameter of core--1.2 mm			32.8
diameter of core--1.4 mm			23.8
Difference of resistance for cores in telephone circuits with length of section 1 km, not more than	ohm	d-c	
diameter of core--1.2 mm			1.6
diameter of core--1.4 mm			1.2
Electrical breakdown point of insulation, not less than	eff. v	d-c	
a) between all cores except signal cores connected with each other and with grounded sheath			1,500
b) between all cores a from one end, and from all cores b, from the other			1,000
c) between all signal cores connected to each other and to grounded sheath			500
Shielding of circuits at far end, not less than	nep	For whole frequency range from 10 to 250 kc in a K-60 section, and from 10 to 110	8.5-8.9 nep for 20% of circuit combinations.

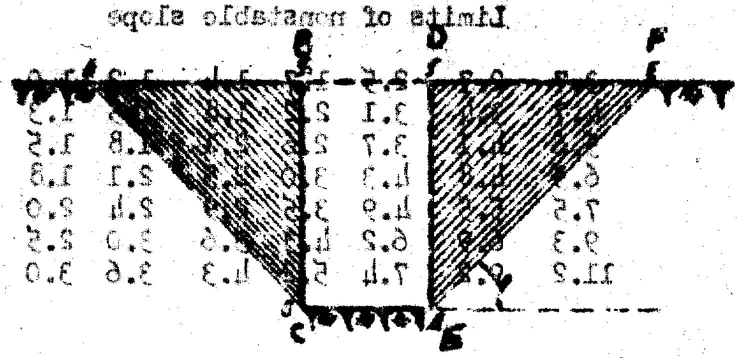
(Table continued on Page 106)

(Table continued from Page 105)

Characteristic	Unit of measure	Frequency of current measured	Standard
		kc in a K-24 section	Temporarily for 7 x 4 cables: 8.4 to 8.7 nep for 20% and 8.8 nep for 80% of circuit combinations
Crosstalk attenuation at near end, not less than	nep	Throughout entire frequency range from 10 to 250 kc in a K-60 section, and from 10 to 110 kc in a K-24 section	7.0 nep At each end, a section in one-circuit combination for 4 x 4 cable, and in two-circuit combinations for 7 x 4 cable, is permissible. For greater capacitance, the value 6.7 nep is permissible on condition that half the total values in any combination of circuits at a given frequency is not less than 7.0 nep.

APPENDIX 3

NATURAL SLOPE ANGLE FOR SOIL AND THE LIMITS OF NONSTABLE SOIL



A B D F

Nonstable
(crumbly soil)

C E

angle of natural slope of soil

Fig. 3.1

ANGLE OF NATURAL SLOPE OF SOIL

Soil	Soil moisture		
	Dry	Moist	Wet
Coarse sand	30°	32°	27°
Medium sand	28°	35°	25°
Fine sand	25°	40°	20°
Loam (foundry)	45°	35°	15°
Humus	40°	35°	25°
Clayey soil	50°	40°	30°

LIMITS OF NONSTABLE SOIL (EXTENT OF AB OR DF)

Depth of ditch, m	Angle of natural slope							
	15°	20°	25°	30°	35°	40°	45°	50°
	Limits of nonstable slope							
1.0	3.7	2.7	2.5	1.7	1.4	1.2	1.0	0.84
1.25	4.7	3.4	3.1	2.2	1.8	1.5	1.3	1.1
1.50	5.6	4.1	3.7	2.6	2.1	1.8	1.5	1.3
1.75	6.5	4.8	4.3	3.0	2.5	2.1	1.8	1.5
2.0	7.5	5.5	4.9	3.5	2.9	2.4	2.0	1.7
2.50	9.3	6.9	6.2	4.3	3.6	3.0	2.5	2.1
3.0	11.2	9.2	7.4	5.2	4.3	3.6	3.0	2.5

APPENDIX 4

Approved by Decree of the Council
of Ministers USSR, No. 577,
dated 6 February 1949.

REGULATIONS
FOR THE INSTALLATION AND MAINTENANCE OF TELEPHONE AND TELEGRAPH LINES OF THE MINISTRY OF COMMUNICATIONS

1. These regulations are disseminated for all telephone and telegraph overhead and cable lines of the Ministry of Communications existing, planned, or under construction.

2. Telephone and telegraph lines of the Ministry of Communications include overhead communications lines; overhead, underground, and underwater communications cables; cable huts; pole crossings; and service and living quarters for line technicians.

3. The Ministry of Communications reserves the right to install and maintain telephone and telegraph communications lines at all land sections including strips bordering railroads and highways and along railroad and other bridges. The installation and modernization of telephone and telegraph lines in the strip bordering highways and railroads are performed in every instance subject to the permission of railroad and highway authorities and after clearing with them the proposed plans.

4. For the construction and operational servicing of telephone and telegraph communications lines, a one-meter strip around overhead line supports is reserved in addition to the area occupied by these supports.

This paragraph of the present regulations does not refer to telephone and telegraph lines laid or to be laid in the strip adjoining highway and railroad thoroughfares nor to the sections of these lines within city limits.

5. The land areas for the construction of work and living quarters on overhead runs and cable communications lines fall outside the highway and railroad right-of-way strips by a distance of not more than 100 m from the communications line runs.

Land areas belonging to collective farms, state farms, and subsidiary organizations of the enterprises and institutions of all ministries, departments, and organizations of the USSR and the Union Republics may be set aside for this purpose only with the permission of the Council of Ministries USSR.

6. For the maintenance and normal upkeep of communications facilities on overhead and cable communications lines, a restricted area is established.

7. The restricted area is that section of land along overhead and cable communications lines defined by straight parallel lines running from the outside conductors and from the cable runs to a distance of:

a) from outside conductors in nonpopulated areas, 2 m on each side;

b) 1 m on both sides of a cable run.

8. The land area in a restricted zone is not to be exempted from agricultural purposes by those normally using it. Line repair personnel of the Ministry of Communications have the right to enter this area without hindrance and to carry out repair operations along cable runs in the restricted zone.

9. In the restricted zone of overhead and cable lines of the Ministry of Communications, it is forbidden

a) to put up any building and, without the written permission of authorities of the Ministry of Communications, to perform any sort of construction work, earthwork, or installation work whether of a permanent or temporary nature;

b) to plant trees without the consent of authorities of the Ministry of Communications;

c) to install the communications lines of other departments, overhead and cable networks, or other line conduits without the permission of the Ministry of Communications;

d) to set up grain stacks, haystacks, turf piles, lumber, etc., field camps, enclosures, grazing areas for horses and cattle; to make fires; to use such zone as a dumping area or for the dumping of slag; to use as a shooting range.

On underground communications cable runs it is forbidden to drop heavy loads (over 5 t) and to pour liquids containing acids, salts, and alkaline substances.

Note. The restricted zone of overhead lines in the right-of-way along highways and railroads may be used for railroad and highway agencies for their own purposes without the consent of communications organizations, but with the strict observance of the present regulations.

The restricted zone for underground communications cables, on the other hand, may not be used without prior agreement from agencies of the Ministry of Communications.

10. It is forbidden to drop anchor; set up wharves, watering places, and fish preserves; or engage in dredging operations (without the consent of the authorities of the Ministry of Communications) along underwater river-cable crossings within a restricted area indicated by signs placed 100 m from the cable on both sides.

11. At the intersections of telephone and telegraph communications lines with highways and railroads, with navigable rivers and streams, canals, areas belonging to industrial concerns, as well as the approaches to civil and military airfields, the organization of the Ministry of Communications building or using the line in question must conclude an agreement with the appropriate department or concern defining the right-of-way and other technical conditions, as well as the way the communications lines are to be used, so that their safety and protection will be assured.

12. For carrying out construction and repair operations, for periodic inspections of communications lines, construction and operation crews and line-repair personnel of the Ministry of Communications have the right to use the strip of land in the restricted zone as required. The inspection of the lines and emergency and routine repair of the lines are to be carried on without hindrance and do not require prior agreement from any institution or organization.

In all other instances, the operations of communications organizations are subject to prior agreement.

13. All organizations (except highway and railroad) which, because of the nature of their activity or because of their location, must carry on operations near the restricted zone of communications lines which are likely to cause damage to overhead lines, to conductors and communications cables (detonations, quarrying, dredging, pouring water, building, demolition, erection or repair of any sort of structure and facility, etc.), are obliged to make a special arrangement with the appropriate oblast, kray, or republic administrations of the Ministry of Communications, outlining the manner in which these operations are to be conducted, the time and place for these operations, as well as all steps to be taken in order to guarantee the security and safety of line and cable communications facilities. The protection of communications lines in places where operations of this sort are in progress is to be provided for by the construction organizations in accordance with the technical specifications of the Ministry of Communications upon orders of, and under the supervision of, a representative of the latter.

14. Plans for constructing communications lines for the benefit of organizations not a part of the Ministry of Communications outside the right-of-way of railroads; wood preserves; factory, port, and industrial lands; the territory of state farms; air fields, etc., must be drawn up in conformance with the regulations for the construction of communications lines of the Ministry of Communications and must be cleared with this Ministry.

15. The selection of runs for constructing power lines, communications and radio broadcast lines, signal lines, for traffic control and blocking lines; as well as measures for the protection of these lines from interference and harmful influences when they run parallel or when they intersect overhead lines and cable lines of the

Ministry of Communications, must be cleared with the latter. Also subject to clearance with the Ministry are runs put down in connection with the construction of electrified railroads (including streetcars) and protection devices against stray currents, as required by inter-departmental regulations.

16. The width for a cut-through in forest areas is determined after consideration of the regulations and instructions regarding the forest economy and forest fire protection as follows:

a) in stands of low-growing trees which do not exceed 4m in height, the width of the cut-through should not be less than the distance between the outside lines plus 4m (2m on each side of the outside lines to the tree branches);

b) in stands where the height is greater than 4m, the width of the cut-through is determined to be the distance between the outside lines of the communications lines plus 6m (3 m on each side of the outside lines to the tree branches), and in some instances, the width will be equal to the height of the trees growing on the edge of the cut-through.

Note: 1. When a communications line passes through parks, orchards, and reservations, a narrower cut-through is permissible by special arrangements with the institutions or organizations concerned.

2. The cut-through passageway in forests for communications lines, as well as the restricted zones, must be maintained in a fire-secure state by the line-technicians of the Ministry of Communications.

3. When a cut-through is to be made across steppes, water preservation areas, and anti-erosion wood belts, it should be done with the least possible damage to the plants or trees so that the protection they afford can continue to be utilized. In particular, the ground should not be cleared of cut brush and undergrowth, and stumps should not be rooted out from crumbly soils, on steep slopes, and in places where the soil is likely to be washed away. Cut-throughs in plantings arranged in narrow rows in the direction of the communications lines should be avoided, and made outside the rows instead.

17. If in the course of the routine maintenance of communications lines, in state forest stands trees are discovered which threaten to fall on the lines, repair technicians should cut them down at once after prior clearance with the appropriate lumber authorities.

Without consent repair technicians of the Ministry of Communications have the right to cut off tree branches for the purpose of maintaining the proper dimensions of the cut-through.

18. In case of damage to communications lines which pass through wood stands, individual trees may be cut down upon consent of the appropriate lumber authorities in order to remove the damage at those places adjoining the communications line runs.

Note. After the trees have been cut down for the purpose of eliminating damage both along the run and outside of it, repairmen are to clear the area of cuttings.

19. Agencies of the Ministry of Communications are permitted to construct roadways, bridges, brushwood roads, and such other facilities along the cut-through as are necessary for the maintenance of the lines.

20. Authorization to undertake earthwork operations and excavations to a depth of more than 0.3m when it is necessary to cut through pavement and sidewalks within city and village limits having cable networks of the Ministry of Communications, may be granted by local soviets of workers' deputies and by individual persons only after prior agreement with administrations or local agencies of the Ministry of Communications.

21. When any organization engaged in earthwork operations discovers an underground cable, it must stop work in the area of the cable and inform the nearest agency of the Ministry of Communications at once.

22. Representatives of agencies of the Ministry of Communications should be issued special passes by the organizations concerned for the purpose of making inspections of, and for operations on, telephone and telegraph communications lines passing through closed-off zones, railroad bridges, tunnels, etc.

23. All organizations and individuals are forbidden to:

a) put up conductors on telephone and telegraph lines of the Ministry of Communications without the knowledge and authorization of its agencies;

b) to erect crossovers for high-voltage and illumination conductors, antennas, and other conductors, or to attach them, without the consent of local administrations of the office of the Ministry of Communications;

c) to cut down trees on runs of telephone-telegraph lines without the consent of the agencies of the Ministry of Communications;

d) to do anything that might cause damage to or disrupt normal communications activities, for example: sawing down posts, supports, attachments; tearing off conductors and guy wires; throwing foreign objects on the wires (wire, kites, hoops, etc.); throwing snow down from a roof onto conductor lines; breaking insulations; connecting anything to communications lines; removing wire clamps on posts;

e) to climb posts, to attach any object whatever to conductors, to open manhole covers on cable wells, to open cable boxes and cabinets, to destroy or damage measurement signs.

24. Enterprises, organizations, collective farms, and house-management offices on whose territory communication lines, conductors, underground cables, and overhead cables pass, must take precautionary measures during repair work, building operations, wrecking operations, erection work, and other community projects to assure that agencies of the Ministry of Communications are given ample warning.

Highway and railroad agencies may work within the limits of their right-of-way without informing agencies of the Ministry of Communications, but they must observe the regulation precautions and assume responsibility for protecting telephone and telegraph lines.

25. When telephone and telegraph lines are damaged from natural causes (ice, floods, drifting ice, hurricanes, etc.), the executive committee of the oblast, rayon, city, or village soviet of workers' deputies must at once furnish assistance to the agencies of the Ministry of Communications for the purpose of re-establishing disrupted communications and assigning a working crew and transportation facilities with payment at established prices.

26. Police agencies must render full cooperation to representatives of the Ministry of Communications in all cases of violation on the part of construction organizations or individuals of regulations regarding the protection of overhead and cable communications lines.

27. Persons guilty of disrupting normal telephone and telegraph communications activities or of damaging line and cable communications facilities will be prosecuted under administration procedures on the basis of the decrees of the local soviets of workers' deputies. In case of premeditated damage and vandalism perpetrators will be tried according to existing criminal procedures.

28. The regulations with respect to safeguarding communications lines are also applicable to the communications lines of other ministries and departments

N. Psurtsev, Minister of
Communications USSR

APPENDIX 5

TABLE OF THE EQUIPMENT WITH TRANSPORTATION FACILITIES AND MACHINERY OF ORGANIZATIONS USING THE CABLE LINES OF INTERURBAN TELEPHONE AND TELEGRAPH COMMUNICATIONS

No.	Item	Unit of measure	Quantity for UKM	RKM	MKU	KU	Remarks
1	GAZ-69A vehicles	unit	1	-	-	-	
2	GAZ-65B vehicles	"	-	1	1	1	
3	GAZ-51 or GAZ-63 vehicles	"	1	2	1	1	
4	ZIL-150 or ZIL 151 vehicles	"	1	1	1	-	
5	ZIS-355 vehicles	"	-	1	1	-	
6	Vehicle tank, with automatic intake	"	1	1	1	-	
7	Bus for meter laboratory	"	1	-	-	-	
8	Trailer, dual-axle	"	1	1	-	-	
9	Trailer, single-axle	"	1	1	-	-	
10	DT-54 tractors	"	-	1	-	1	Completely fitted out for overland movement
11	S-80 tractors	"	1	-	-	-	
12	ZhES-9 movable electro-stations	"	1	-	-	-	
13	Lighting units	"	-	2	2	1	
14	ZIF-55 movable compressors	"	-	1	1	-	
15	Cable trailers (for hauling cable	"	1	1	1	-	
16	M-300 motor pumps	"	-	1	1	1	
17	"Lyagushka" hand pumps	"	-	2	2	1	
18	1-1.5 ton hand winches	"	-	1	1	1	
19	Half-ton block and tackle	"	-	1	1	1	
20	Jack-carriage for 3 tons	"	-	1	1	1	
21	BG-1 horizontal drill	"	-	1	1	-	
22	Bicycles	"	-	-	-	6	
23	M-72 motorcycles (with side-car)	"	-	1	1	1	
24	Motor boats	"	-			1	For organizations with cable crossings over navigable rivers

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(Table continued from Page 115)

No.	Item	Unit of measure	Quantity for UKM	RKM	MKU	KU	Remarks
25	Skis	unit	-	-	-	6	
26	3-ton automatic cranes	"	1	1		-	
27	Cable riggers	"	1	-	-	-	
28	Horses	"	-	-	-	4	Completely fitted out for over-land movement

APPENDIX 6

STANDARD LIST OF STAND-BY EQUIPMENT, INCLUDING TOOLS, MATERIALS, AND OTHER ITEMS FOR EMERGENCY REPLACEMENT AND FOR PREVENTIVE MAINTENANCE WORK

No.	Item	Unit of measure	Quantity for KU	Quantity for RVB	Remarks
1	Cylinders for calcium chloride	unit	2	2	
2	5-liter gasoline containers	"	2	2	
3	20-liter gasoline containers (canisters)	"	1	1	
4	Iron water pails	"	2	2	
5	Iron pails for heating	"	1	1	
6	Soldering pails	"	2	3	
7	Funnels	"	2	3	
8	Concave mirrors in case	"	2	3	
9	300-mm locksmith chisel	"	2	3	
10	170-mm " "	"	2	3	
11	Tent frames	"	2	3	
12	Soldering torch needles	"	10	15	
13	Oilcloth (oiled on both sides)	"	2	3	
14	Steel wedges	"	4	4	
15	Socket wrench	"	2	3	
16	Monkey wrench	"	2	3	
17	Double-ended wrenches, 17, 19, 22, 24	"	2	3	
18	Scoops for melting solder	"	1	1	
19	Repairmen's grapplers (claws)	"	1	1	
20	10-kg sledge hammer	"	2	2	
21	Lateral cutting pliers, 130-150 mm	"	2	3	
22	Straight " " 200 mm	"	2	3	
23	1-liter soldering torch	"	2	3	
24	Half-liter " "	"	2	3	
25	Steel measuring tapes, 20 m	"	1	1	
26	3-meter ladder	"	2	3	
27	Steel crowbars	"	2	3	
28	Steel spades	"	6	8	
29	Steel snow shovels	"	4	6	
30	Manometer, 3 atm	"	2	2	
31	Steel folding tapes	"	2	3	

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(Table continued from Page 117)

No.	Item	Unit of measure	Quantity for KU	Quantity for RVB	Remarks
32	Handsets	unit	7	6	
33	Micrometer	"	2	3	
34	Hammers	"	2	3	
35	Mallets	"	2	3	
36	3-sided files	"	2	3	
37	3-sided smooth-cut files, 250 mm	"	2	3	
38	3-sided files, 150 mm	"	3	3	
39	Hand pumps for pumping air into cables	"	2	3	
40	Metal hacksaws	"	2	3	
41	Cable knives	"	2	3	
42	Repairmen's knives	"	2	3	
43	Steel drum shafts, 70-80 mm	"	1	1	
44	Steel drum shafts, 40-50 mm	"	1	1	
45	Steel screwdrivers	"	2	3	
46	Repairmen's tents, 2.5 x 3 m	"	2	2	
47	Small conical tents	"	2	3	
48	Soldering iron	"	2	3	
49	" " , straight	"	2	3	
50	" " , hammer-shaped	"	2	3	
51	Crosscut saw	"	1	1	
52	Flat-nosed combination pliers	"	2	3	
53	Flat-nosed pliers, 200 mm	"	2	3	
54	Duck-nosed pliers, 150 mm	"	2	3	
55	Metal hacksaw blades	"	8	12	
56	Repairmen's belts	"	1	1	
57	Iron "protvini"	"	1	1	
58	Saw set	"	1	1	
59	Canvas gloves	pair	20	20	
60	20-meter tape measure	unit	2	3	
61	First-aid kit	"	1	1	
62	Repairmen's case	"	2	3	
63	Tool box	"	2	3	
64	Tamping iron	"	2	2	
65	Magneto telephone set	"	2	2	
66	D-c bell	"	2	3	
67	Thermometer, to 250 °	"	2	3	
68	Hand vice, 45 mm	"	1	1	
69	Carpenter's ax	"	2	2	
70	Number stencils	set	2	-	
71	Flashlight, pocket	unit	4	6	

(Table continued on Page 119)

(Table continued from Page 118)

No.	Item	Unit of measure	Quantity for KU	Quantity for RVB	Remarks
72	"Letuchaya mysh'" flashlight	Unit	2	2	
73	Steel brushes	"	2	3	
74	Portable electric lights with cord in rubber hose	"	6	8	
75	Rubber mats	"	2	3	
76	Felt mats	"	2	3	
77	Goggles	"	2	3	
78	Universal cutting clamps	"	2	2	for installing coaxial pairs, 2.52/94
79	Special brackets	"	8	8	
80	Washer mounters	"	2	2	
81	Templet	"	2	2	
82	Soldering tongs	"	2	2	
83	Rubber expansion discs	"	4	4	
84	Short pointed scissors	"	2	2	
85	Crimping tongs	"	2	2	for installing coaxial pairs, 5/18
86	Sapper's scissors	"	2	2	
87	Control unit	"	2	2	
88	"Petrovich" unit	"	1	1	
89	Cable shaper	"	2	2	
90	Revolving clamps	"	1	1	
91	Hand winch for 1 ton	"	1	1	
92	Stick tips	"	1	1	
93	Standard guard rail	"	2	2	
94	Threaded rods for making channels	"	150	150	
95	Hemp ropes, 12 mm	m	250	250	
96	Hemp ropes, 18 mm	"	250	250	
97	Steel cable 5/18	"	250	250	
98	Level	unit	1	1	
99	Flashlight with red glass	"	2	2	
100	Cylinders	"	2	1	
101	Steel housings, 50 pairs	"	2	2	
102	" " 100 pairs	"	2	2	
103	" " 300 pairs	"	2	2	
104	" " 600 pairs	"	2	2	
105	" " 1200 pairs	"	2	2	
106	" ", transit, 50 pairs	"	2	2	
107	" " 100 pairs	"	2	2	

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(Table continued from Page 119)

No.	Item	Unit of measure	Quantity for KU	Quantity for RVB	Remarks
108	Steel housings, 300 pairs	Unit	2	2	
109	" " 600 pairs	"	2	2	
110	" " 1200 pairs	"	2	2	
111	Test balloons, 82 mm	"	2	1	
112	" " 92 mm	"	2	1	
113	Brushes for cleaning channels, 90 mm	"	2	1	
114	" " " channels, 100 mm	"	2	1	
	Materials				
1	Gasoline, 1st quality	kg	40	40	
2	Gasoline, commercial	"	200	50	
3	Batteries for pocket flashlight	unit	10	10	
4	Cable paper	kg	0.4	0.4	
5	Rags	"	1.0	1.0	
6	Paper cartridges	unit			
7	Numbered "				based on calculation for 3 cable sleeves of maximum capacity
8	Rosin	kg	0.1	0.1	
9	Granulated calcium chloride	"	4.0	4.0	
10	Kerosene	"	20	20	
11	Etching hydrochloric acid	"	0.05	0.05	
12	Insulating tape	"	0.5	0.5	
13	Lightbulbs	unit	3	3	
14	Material for filling iron sleeves	kg	15	15	
15	Copper-aluminum patch cord	unit		as required	
16	Calico	m	1.0	1.0	
17	Cable type iron sleeves	unit	2	2	
18	Coarse thread	kg	0.04	0.04	
19	Copper wire, d=1.4 mm	"	0.3	0.3	
20	Galvanized steel wire, 1.2-2 mm	"	0.3	0.3	
21	PRVPM wire, d=1.2 mm	m	3000	3000	
22	POS-30 wire	kg	6.0	6.0	
23	POS-40 wire	"	0.5	0.5	
24	Cable-type lead sleeves	"	4	4	
25	"Steorin"	"	0.2	0.2	

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No.	Item	Unit of measure	Quantity for KU	Quantity for RVB	Remarks
26	Flux for soldering or welding aluminum cores	kg	0.05	0.05	
27	Dry elements 3s MVD	unit	8	8	
28	Copper bushings, 20 x 4	"	16	16	
29	Copper semisleeves, 70 x 13.6	"	32	32	for installing coaxial pairs, 2.52/9.4
30	Steel semisleeves, 94 x 17	"	32	32	
31	Ebonite washers, small	"	96	96	
32	" " large	"	16	16	
33	POS-60 solder with rosin	kg	0.2	0.2	
34	Small brass compression rings	unit	64	64	
35	Steel rings, numbered	"	16	16	
36	Large brass compression rings	"	32	32	for temporary patches to coaxial pairs, 2.59/9.4 and 5/18
37	Flexible coaxial cable, RK-3 or RK-1	"	1800	1800	
38	Thrust bushings	"	10	10	
39	Brass rings, tinned for attaching half-sleeves	"	10	10	for installing coaxial pairs
40	Brass rings, tinned, slit	"	10	10	
41	Tinned half-sleeves	"	10	10	
42	POS-60 solder with rosin	kg	10	10	
43	Copper, tinned plate, 0.5 mm	"	5	5	
44	Bracket bolts with nuts	unit	0.3		for one channel-kilometer of cable conduit
45	Beams, diameter 20-25 cm	m^3	0.01		
46	Rope, diameter 18 mm	kg	0.05		
47	Rags (waste)	"	0.3		
48	Petroleum asphalt	"	0.57		
49	Boards, assorted	m^3	0.01		
50	Firewood	"	0.05		
51	Ragbolts for angle brackets	unit	0.05		
52	Iron, assorted kinds	kg	3.0		

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No.	Item	Unit of measure	Quantity for KU	Quantity for KVB	Remarks
53	Gray putty	kg	2.0		
54	Locks for manhole wells	unit	0.3		
55	Kerosene	kg	0.3		
56	Construction bricks	unit	15		
57	Manhole well bracket	"	0.1		
58	Angle bracket for manhole well	"	0.1		
59	Iron covers, top	"	0.02		
60	Iron covers, bottom	"	0.1		
61	Gray paint	kg	0.2		
62	Paint, minimum	"	0.86		
63	Iron manhole hatch with covers	unit	0.01		For one channel-kilometer of cable conduit
64	Drying oil	kg	0.3		
65	Resin fibre packing	"	0.5		
66	Concrete blocks	unit	0.1		
67	River sand	m^3	0.01		
68	Wood plugs	unit	0.3		
69	Straight steel wire, 4 mm	kg	0.4		
70	Tar paper lining	role	0.004		
71	Conduit pipe	m	0.5		
72	Cement	kg	5.0		
73	MKVP cable	m	100	500	

APPENDIX 7

STANDARD LIST OF THE MOST NECESSARY TOOLS AND MATERIALS ISSUED TO A BRIGADE AND KEPT IN TOOL CASES (FOR A BRIGADE OF TWO PERSONS)

No	Name of tool or material	Unit of measure	Quantity	Notes
1	3-liter gasoline cans	unit	1	
2	Funnel	"	1	
3	Concave mirror with case	"	1	
4	300-mm locksmith's chisel	"	1	
5	170-mm " "	"	1	
6	Soldering torch needles	"	2	
7	Oilcloth (oiled on both sides)	"	1	
8	Monkey wrench, No. 2	"	1	
9	Socket wrench	"	1	Load coil box type
10	Double-ended wrench	"	2	
11	Lateral cutting pliers, 130-150 mm with insulated handles	"	2	
12	Straight cutting pliers	"	1	
13	1-liter soldering torches	"	1	
14	Half-liter " "	"	1	
15	Folding rule	"	1	
16	Handsets	"	2	
17	Hammers	"	1	
18	Mallets	"	1	
19	3-sided files	"	1	
20	Cable knives	"	1	
21	Repairmen's knives	"	1	
22	Metal hacksaws	"	1	
23	Screwdrivers	"	2	
24	Solder iron	"	1	
25	" " straight, 0.5 kg	"	1	
26	" " " , 0.3 kg	"	1	
27	" " hammer-shaped, 0.3 kg	"	1	
28	Flat-nosed pliers, 200 mm with insulated handles	"	1	
29	Duck-nosed pliers with insulated handles	"	1	
30	Hacksaw blades	"	3	
31	Canvas gloves	pair	2	
32	20-meter tape measure	unit	1	
33	First-aid kit, in case	"	1	
34	Magneto telephone set, TAI-43	"	1	
35	Pocket flashlight	"	2	

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No	Name of tool or material	Unit of measure	Quantity	Notes
36	Steel brushes	Unit	1	
37	Rubber mats	"	1	
38	Felt mats	"	1	
39	Goggles	"	1	
40	Gasoline, highest grade	kg	5	
41	Batteries for flashlight	unit	2	
42	Cable paper	g	50	
43	Rags	"	500	
44	Paper cartridges	unit	200	
45	Paper cartridges, numbered	"	50	
46	Rosin	g	20	
47	Hydrochloric etching acid	"	50	
48	Calico	m	0.3	
49	Coarse thread	g	10	
50	POS-30 solder	kg	5	
51	POS-40	"	0.2	
52	Universal crimper-cutters	unit	1	
53	Special brackets	"	3	For cables with coaxial pairs, 2.52/9.4
54	Washer mounter	"	1	
55	Templet	"	1	
56	Soldering tongs	"	1	
57	Rubber expansion discs	"	2	
58	Short pointed scissors	"	1	
59	Copper bushings, 20 x 4	"	8	
60	Copper half-sleeves, 70 x 13.6	"	16	
61	Steel half-sleeves, 94 x 17	"	16	
62	Ebonite washers, small	"	48	
63	" " large	"	8	
64	POS-60 solder with rosin	kg	0.1	
65	Steel rings, numbered	unit	8	
66	Large brass compression rings	"	16	
67	Small " " "	"	32	
68	Squeezing tongs	"	1	
69	Sapper's scissors	"	1	For use with cables having coaxial pairs, 5/18

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No	Name of tool or material	Unit of measure	Quantity	Notes
70	Thrust bearings	unit	4	
71	Brass rings, tinned for attaching half-sleeves	"	4	
72	Brass rings tinned, slit for inside conductor		4	
73	Copper, tinned plate	g	40	
74	Tinned half-sleeves	unit	4	
75	Copper-aluminum patch	"	250	For use with cable having aluminum cores
76	Welding flux	"	80	

APPENDIX 8

INSTRUCTIONS FOR STORING THE OPERATIONAL RESERVES OF INTERURBAN CABLES AND LOADING-COIL CASES

1. An emergency operational reserve of cable must be kept in a closed-off space or under an awning.

2. Free passage to the cable storage place must be provided for vehicles at any time of the year or at any time of day.

3. Cables must be wound on solid wood or iron drums, and the diameter of such drums should be suitable for the cable wound thereon (the radius of cable winding should be not less than 15 times its outside diameter).

4. Lead sheathing on cable leads wound on a drum should be carefully sealed. An automobile tire valve should be soldered to the end of the inside cable lead, and dry air, in the amount of one atm, should be pumped in. This pressure should be maintained constantly. The inside cable lead, brought outside, should be carefully protected from shock. It should be accessible, without having to unwind the cable, for electrical measurements and checks on the air pressure.

The outside end of the cable should be affixed to the inside hollow of the drum.

5. Each drum should have a solid covering of one row of boards, and the nails holding the boards should be driven through a steel band or through wire braided around the nails.

On the outside of each drum (or on a card securely attached to the drum) there must be an indelible inscription giving the following information:

a) type and design of cable;

b) length in meters and weight in kilograms;

c) date of delivery of drum to warehouse;

d) name of factory and year of manufacture of cable (if cable was received from a factory);

e) location of outside end of cable so that it will not be necessary to remove a large number of boards for testing purposes;

f) an arrow indicating direction for turning the drum when it is to be rerolled.

7. An inspection certificate must accompany each cable drum received at the warehouse. This certificate is to give the results of electrical measurements of cable cores (resistance of insulation, test of cores to be sure they are unbroken), and of tests of cable sheath by means of air pressure.

8. If several pieces of cable are wound on a drum, the inscription on the drum should give information relating to each piece. In addition, if the pieces have been used, information should be given as to whether or not they are fit for laying.

Each piece of a cable must be equipped with an air valve, as indicated in par. 4.

9. Cable drums must stand on a level spot, and wooden blocks should be placed under the sides for support. If necessary, bricks should be used for this purpose if the drums are kept on scaffolds under an awning.

When drums are kept in the open, they should be put on blocks to keep them from rotting, and, in addition, they should be covered with tar paper.

10. Cable drums should be arranged in warehouse spaces in such manner as to satisfy the following requirements:

a) free access to each drum;

b) arrangement of drums so that removing one will not disturb the others;

c) arrangement of cables by type.

11. When a large number of various types of cables are stored in a warehouse, it is recommended that a plan be drawn showing where the drums of various types and lengths are located.

12. Equipment for loading and unloading cable drums (cranes, knolls, gantries, etc.) should be on hand in warehouses. An "apparel'" may also be used for this purpose. An "apparel'" is a sloping hole dug deep enough into the ground so that within it the floor of a truck is exactly even with the level at which the drums are to be loaded and unloaded.

If an enbankment (knoll) is to be used as a loading platform, its horizontal part must be at least 15 times the diameter of the largest drum. The horizontal platform must be at the same level as the floor of the truck.

13. Cables must be protected from shock and from fire when they are in a warehouse. Required fire-fighting equipment is to be determined by local fire-defense agencies.

14. From one to three full cable drums with the principal cable types for a particular main-line section are to be kept at all warehouses and at loading platforms where cables are to be loaded quickly onto trucks.

Note. Conditions for keeping individual drums dispersed along a run must conform to all the requirements of these instructions.

15. Loading-coil boxes are kept in a closed place or under an awning, and are to be set up on blocks.

The inside sleeve must be carefully welded both at the ends and along the sides. The quality of the weld should be checked by means of forced dry air.

APPENDIX 9

TABLE OF MEASURING EQUIPMENT REQUIRED FOR ASCERTAINING THE ELECTRICAL CONDITION OF CABLES, DETERMINING THE LOCATION OF DAMAGE, DETERMINING THE EXTENT OF CORROSION AND LIGHTNING PROTECTION, CHECKING THE PRESSURE IN CABLES, LOCATING LEAKS IN LEAD SHEATHING, AND ASSURING SAFETY DURING SUCH OPERATIONS

No	Item	Unit of measure	Quantity for UKM lab.	RKM meas. group	KU	RVB	UP	Remarks
1	Autotransformer, laboratory type LATR-1	unit	2	2	-	-	-	
2	Same, LATR-2	"	2	1	-	-	-	
3	Ampere-volt meter, type AVO-5m, to 6 kv	"	1	1	-	-	-	
4	Voltmeter, vacuum tube, universal type VLU-2, with voltage divider, DNE-7 to 5 kv	"	1	1	-	-	-	
5	Visual crosstalk attenuation meter, to 300 kc, type VIZ-300	set	1	1	-	-	-	
6	Multirange voltmeter, to 600 v and 6 amp, type Ts-315, class 1.5	unit	1	1	1	-	-	
7	Audio frequency generator, type 3G-2a to 20 kc	"	1	-	-	-	-	
8	Galvanometer, d-c, type GMP, sensitivity 1.10^{-6} amp per division for bridge circuits	"	1	1	1	-	-	
9	Galvanometer, d-c, type M-322, sensitivity 0.5 to 10^{-6} amp per division	"	1	1	1	-	-	
10	Ground meter and specific ground resistance meter, MSO.7	"	1	1	1	-	-	
11	Tube tester, IL-14	"	1	1	-	-	-	
12	Meter case, type ICh	"	1	1	-	-	-	
13	Frequency meter, type ICh-6, to 100 kc	"	1	-	-	-	-	
14	Meter console, type IP-300	"	1	-	-	-	-	

(Table continued on Page 129)

(Table continued from Page 128)

No	Item	Unit of measure	Quantity for UKM lab.	RKM meas. group	KU	RVB	UP	Remarks
15	Universal pulse meter, type UIP-4K	Unit	1	1	-	-	-	For coaxial pair
16	Line cable tester, type IKL-5	"	1	1	-	-	1	
17	Set of instruments for measuring crosstalk attenuation, type KIPZ-300	set	1	1	-	-	-	
18	Set of instruments for measuring asymmetry capacitance, type IYeA	"	-	1	-	-	-	
19	Set of instruments for measuring attenuation mismatching	"	1	-	-	-	-	
20	Set of instruments, type KS, for measuring coaxial cables	"	1	-	-	-	-	For multiplexed main lines to 10 Mc
21	Modernized cable instrument, type PKP-56	Unit	1	1	1	2	1	
22	Cable finder, modernized type KI-56	"	1	1	1	2	-	
23	Hf bridge, type MPS-300	"	1	1	-	-	-	
24	Megohm meter, type M-1101, to 1,000 megohms	"	-	1	1	1	-	
25	Attenuation box, type MZU, to 11 nep, 60 kc	"	1	1	-	-	-	
26	Attenuation box, type IRZU, to 11 nep, 150 kc	"	1	1	-	-	-	
27	Resistance box, lever type KMS-6 to 100,000 ohms, class 0.1	"	1	1	-	-	-	
28	Resistance box, high ohm, type MSV	"	1	1	-	-	-	
29	Resistance box, plug type R-58, to 100,000 ohms	"	1	1	-	-	-	
30	Capacitance box, lever type ME-3 to 1.11	"	1	1	-	-	-	

(Table continued on Page 130)

(Table continued from Page 129)

No	Item	Unit of measure	Quantity for UKM lab.	RKM meas. group	KU	RVB	UP	Remarks
31	Capacitance box, plug type ME-4 to 2 microfarads	Unit	1	1	-	-	-	
32	D-c bridge, universal modernized type UMV	"	1	1	1	1	1	
33	Rheochord bridge, type R-38	"	1	1	-	-	-	
34	Oscillograph, electronic, with single sweep, type 254, for frequency band from 20 cycles to 6 Mc	"	1	-	-	-	-	
35	Universal puncture device, type UPU-1	"	1	1	1	-	-	For coaxial cables
36	Stray current meter, type PBT	"	1	1	1	-	-	
37	Discharge tester, R-350	"	1	1	1	-	-	
38	Interference voltage indicator, UNP-2	"	1	-	-	-	-	
39	High voltage indicator, type UVN-80	"	1	1	1	1	1	
40	8-step measuring filter, type F-6, to 20 kc	"	1	-	-	-	-	
41	Manometer, monitoring, to 1.6 atm, class 0.35	"	1	2	1	-	-	
42	KID instrument (set for individual dosimetry control)	"	1	1	-	-	-	For use in locating leaks in lead sheathing by means of radioactive isotopes
43	"Techeiskatel' galloidnyy," type GTI-2	unit	2	1	1	-	-	For use in applying "gazofreon-22"

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